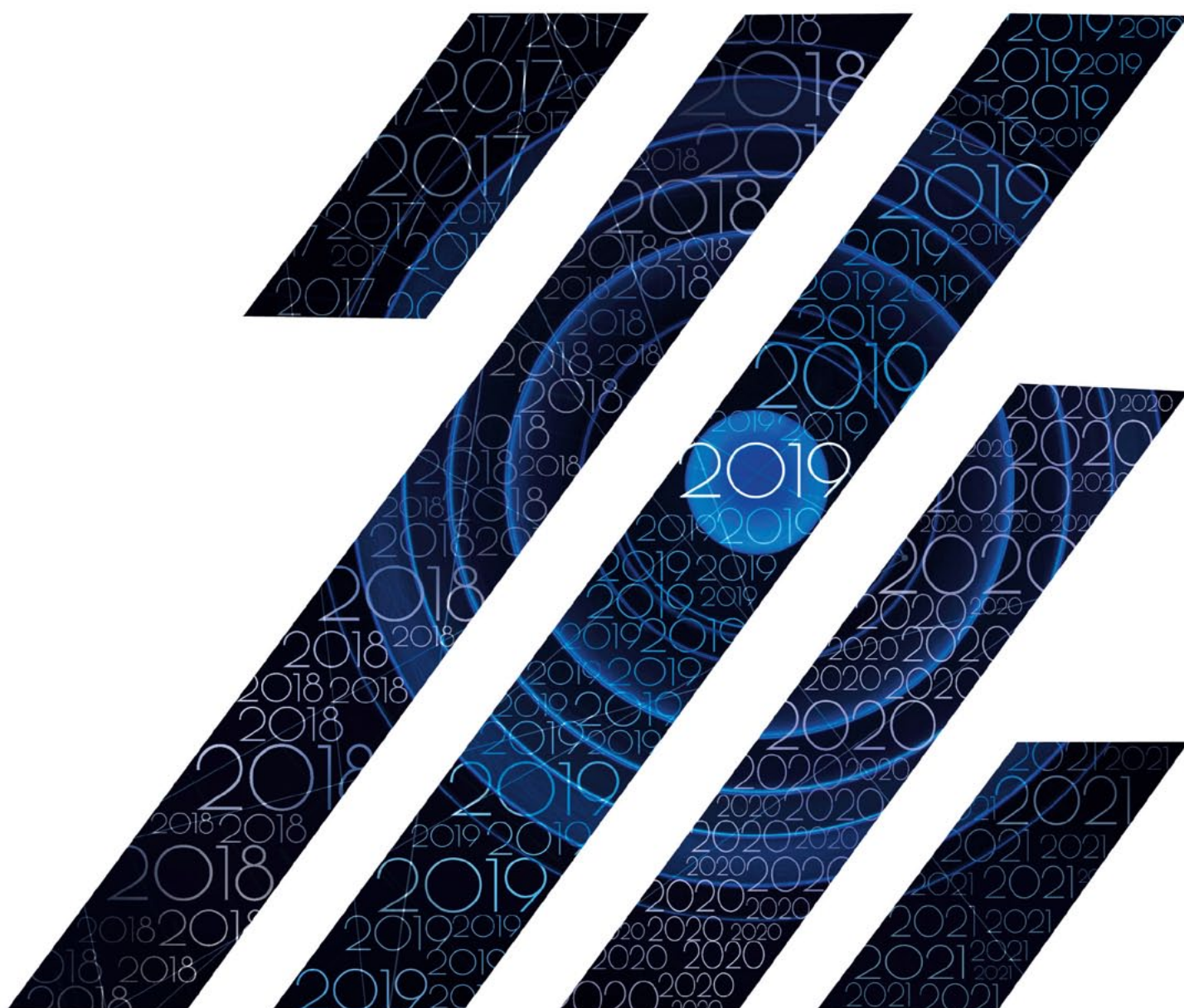NATIONAL CENTRE FOR
SCIENTIFIC RESEARCH "DEMOKRITOS"

Industrial
Fellowships
Program
2017-2019

Investing in new knowledge and technology Creating growth and employment in Greece

Made possible by a grant from the Stavros Niarchos Foundation

Two years ago the National Centre for Scientific Research "Demokritos" launched the Industrial Research Fellowship Program, made possible by a generous donation from the Stavros Niarchos Foundation. The Program is aimed at talented Researchers, Doctoral Candidates or at a Postdoctoral level with a strong interest in applied, industrial research.

All the Fellows have been selected for either three or four-year tenures after open calls for proposals, followed by peer-reviewed processes by a network of Experts from Universities and Research Centers from all over Greece. Each project was reviewed by at least two experts. The evaluation criteria were focused on the excellence of the Applicants'academic profile, the scientific merit of their proposals and the degree of commitment and involvement of the supporting Companies in the proposed research.   The progress of each Fellow has been closely monitored and evaluated every year by Committees of Researchers set at Demokritos.

It is today with joy and a sense of pride that we present the progress and the achievements of all the participants. We hope that these last two years have been productive and fruitful for the Fellows and for the Companies that sponsor them. For Demokritos the SNF Industrial Fellowship Program is a unique and wonderful experience. It has not only paved the way for more successful collaborative research projects attracting European and National grants, but predominantly for a change of culture in the Centre and the way we interact with innovation-driven companies. A mindset for technology transfer has been established and innovative ideas that are bloomed in the Centre's laboratories are beginning to get the support they deserve.

Knowledge-based economy has long been considered to be an impossible target for Greece. Against these odds at Demokritos we are dedicated in sustaining and growing a dynamic ecosystem that nourishes research talent and innovative entrepreneurship.

The Board of Directors of "Demokritos" congratulates each and every one of the Fellows and the participating Companies. Once again we express our gratitude to the Stavros Niarchos Foundation for believing that Demokritos could produce high-impact industrial research in collaboration with some of the most dynamic Greek companies and for making the entire Program possible.

On behalf of the Board of Directors
Georgios Nounesis, Chairman

ENTERPRISES

INDUSTRIAL FELLOWS

Industrial
Fellowships
Program
2017-2019

Materials & Membranes
for Environmental
Separations Laboratory
**Institute of Nanoscience
and Nanotechnology**

Scientific Mentor:
Evangelos P. Favvas

SNV
ENGINEERING

Company Mentor:
Dionysis Skamnakis
www.snveng.gr

ANGELOPOULOS S. EVANGELOS

Design and Development of
a Low Cost Sensor for Qualitative and
Quantitative Assessment of Diesel Fuel

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Almost two years after the kick-off the project and due to the commercial launch of NBIoT networks in Greece (May 2019) our project has brought to commercialization the first two initial products:
1. A Capacitance NBIoT Diesel Fuel Level Sensor for the characterization of fuel tanks operating in atmospheric pressure. The sensor has reached a TRL level readiness of 9 (actual system proven in operational environment). Industrialization is under way. The sensor has been gradually installed in various Pilot projects whereas it has been already provide to clients of SNV Engineering. The first project in Greece under contract is being delivered within May 2019.
2. A Pressure NBIOT sensor for water. The water pressure sensor has been developed using membrane technology from the Materials & Membranes for Environmental Separations Laboratory and has reached a TRL level of 9.
Although this sensor is currently out of scope, since the liquid under characterization is water and various other types of water (grey water, industrial water, sewage water, etc), for SNV Engineering Ltd the water sensor creates a new market in the APAC region, where water level of tanks either man-made (reservoirs, cisterns) or nature-made (lakes, rivers, etc) are of special interest.
Currently the team works on a specific membrane technology tailor-made to characterize diesel tanks using pressure. Once the recipe of the membrane is concluded, a second type of characterization sensor of diesel tanks will be launched. So far, this project has reached maturity of TRL equal to TRL 4.

Conferences
- Hub:raum IoT Academy, Athens, Greece, 2017
- CeMAT, Hannover Messe, Germany, 2018
- "Smart University Campus" Conference, Demokritus University of Thrace, Greece, 2018
- Smart City Expo World Congress, Barcelona, Spain 2018
- 1st Sustainable Conference, Cypriot Institute of Technology, Cyprus, 2018
- 4th technology conference, Naftemporiki, Athens, Greece, 2019

Other distinctions
- Tetramax Cascaded Funding: Successful application and raise of 25.000 euro

DEMOKRITOS
NATIONAL CENTRE FOR SCIENTIFIC RESEARCH

ANGELOPOULOU MICHAILIA

Development of Methods for Rapid Simultaneous Detection of Multiple Bacteria Species in Milk and Juices Through Mach-Zehnder Interferometers Array

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Immunoassays & Immunosensors Laboratory
Institute of Nuclear & Radiological Sciences & Technology, Energy and Safety

Scientific Mentor:
Sotirios Kakabakos

Company Mentor:
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The main proposal objective is the fast detection of pathogen and/or spoilage bacteria in milk and juices using Mach-Zehnder interferometer (MZI) arrays integrated on silicon chips. The study targets the simultaneous detection of two pathogens, namely Salmonella spp. and Escherichia coli in milk, and one spoilage bacteria, Alicyclobacillus acidoterrestris, in juice samples through a state-of-the-art label-free sensor, already developed by NCSR "Demokritos" (NCSRD) that is, for the first time, employed for bacteria detection. To achieve this goal, a rabbit polyclonal antibody was developed, in cooperation with Dr. E. Livaniou, for A. acidoterrestris and appropriate antibodies against S. typhimurium and E. coli were selected from the international market. All the antibodies were characterized by high titters, and the respective ELISAs developed were sensitive with detection limits (LODs) for all three bacteria around 103 cfu/mL. The ELISA assay protocols were transferred to the MZI chip and further optimized.

To transform the chip to biosensor, its surface was activated through oxygen plasma and modified with aminosilane followed by an appropriate microspotting protocol for selective spatial activation of each single MZI on the chip with specific biorecognition moieties. To improve the sensor performance, three different fluidic modules, plain, S-shape and serpentine, were tested and the latter exhibited the optimum characteristics in terms of signal repeatability and detection sensitivity. Employing a 3-step assay configuration, the detection of S. typhimurium and E. coli was achieved in a total assay time of 10 min with LODs down to 2x102 cfu/mL.

ANTONIOU MYRSINI KYRIAKI

Advanced Multifunctional Coatings for Outdoor Applications

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Membranes and Materials for Environmental Separations Laboratory (MESL)
Institute of Nuclear & Radiological Sciences & Technology, Energy and Safety

Scientific Mentor:
Andreas Sapalidis

Company Mentor:
Dimitrios Kokkonis
www.berling.gr

The proposed project is aiming at the development of novel, high-performance multifunctional paints\coatings combining hydrophobic/self-cleaning/anti-icing properties with mechanical durability and enhanced weather stability.

To that end, incorporation of specially developed silica-based nanoadditives will be pursued in actual coatings formulations.

Special attention is given to the structural characteristics (such as size, shape, apparent density) of silica nanoparticles and their surface functionalization, attaching appropriate functional groups that will impart poor water wetting to the final coating. In particular, cubic siloxanes (silsesquioxanes) have been synthesized from the hydrolytic condensation of an organosilicon precursor, allowing the design and "construction" of materials with extremely well-defined dimensions and behavior.

Cubic siloxanes of the type $X_8Si_8O_{12}$, where X can be a single or a more complex functional group, have been employed as precursor reagents.

The silylating reagents exhibit different end groups (e.g. methyl, fluoro groups) and different alkyl chain lengths. Moreover, monodisperse and uniform-sized silica nanoparticles have been prepared using ultrasonication during the sol–gel process. The nanoparticles are obtained by hydrolysis of silica precursors in ethanol medium.

Conferences
- EUROPT(R)ODE XIV, Naples, Italy, 2018
- 11th Aegean Analytical Chemistry Days (AACD2018), Crete, Greece, 2019

Conferences
- 12th Pan-Hellenic Scientific Conference of Chemical Engineering, Athens, Greece, 2019

AMENTA MARIA

Development and Evaluation of Self Healing Cement Composites by Incorporation of Encapsulated Inorganic Admixtures and Hydraulic Phases

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Laboratory of Archeological
& Building Materials
**Institute of Nanoscience
and Nanotechnology**

Scientific Mentor:
Ioannis Karatasios

Company Mentor:
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The aim of the project is the development of self-healing cement composites with the ability to repair micro-cracks and defects of the cement matrix without the need of external intervention. Thus, ensuring the improved durability of structures, reduced maintenance cost and a lower environmental footprint.
The main research objectives include:
a) development and evaluation -at laboratory scale- of a group of self-healing cement composites that will incorporate different types of encapsulated healing agents, such as active mineral admixtures and hydraulic phases and
b) development of an encapsulation methodology and optimization of solid dispersion parameters, mechanical properties of the produced microcapsules, rheological properties of wet mixtures, microstructural and mechanical properties of hardened mixtures.
During the first two years of the project implementation the following objectives have been achieved:
1. the healing efficiency of several types of healing admixtures incorporated in mortar mixtures was assessed, including crystalline admixtures, cementitious materials, expansive agents as well as nano-structures like GOnPs,
2. limitation factors pertaining to the self-healing efficiency were studied, such as time when cracking occurs, healing period, crack width etc.
3. quantification of self-healing efficiency was established, by developing methodological protocols for assessing the crack recovery sealing effect against water permeability, water absorption and strength recovery after compressive and flexural damage
4. two encapsulation methodologies were developed, aiming to the production of core-shell particles of varying diameter and cargo capacity.
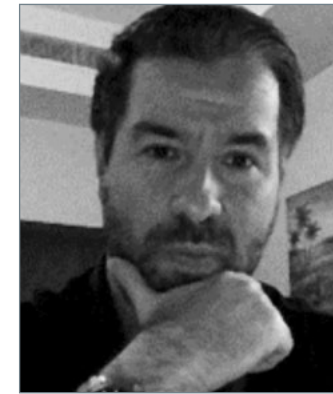
ARGYROPOULOS CHRISTOS

Quantitative risk Assessment of Accidental Releases of Hazardous Materials in an Oil Refinery and the Surrounding Area

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Membranes and Materials
for Environmental Separations
Laboratory (MESL)
**Institute of Nuclear &
Radiological Sciences
& Technology, Energy
and Safety**

Scientific Mentor:
Nivolianitou Zoe

Company Mentor:
Evangelia Stefa
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During the nine-month period (09/2018 – 05/2019) the following objectives of the project were achieved. All the goals of work package (WP) 1 and one objective of WP2 were fulfilled according to the initial time schedule. More specifically, a comprehensive literature review was undertaken for semi-empirical (integral) and CFD models for pollutant dispersion from complex industrial facilities (e.g. tank farms). As a result, the collected material was used for the preparation of a review paper. The main goal of WP1 was to gain an insight into the performance of the models along with their capabilities and limitations. The review also helped us to select the most appropriate model for our considered cases.

Subsequently, two meetings with Motor Oil Hellas (MOH) were held for discussing the initial selection of the appropriate accident scenarios and for collecting the appropriate material (e.g. safety study, P&IDs, Emergency plans) for the considered study (first meeting). In the second meeting, I delivered the first version of a technical report regarding the assessment of large hydrocarbon tank fire scenarios in the area of oil refinery. Then, I discussed the results of my study with my mentors and high-experienced personnel from MOH in order to assess and compare the obtained results with previous studies.
Currently, I gain experience with the integral code SOCRATES in order to begin the model development for the considered cases according to the time schedule and the last meeting with MOH.

Conferences
- FraMCoS X- Fracture mechanics of Concrete and Concrete structures, Bayonne, France, 2019
- National Scientific conference on Chemical Engineering, Athens, Greece, 2019
- Historic Mortar Conference, Pamplona, Spain, 2019

BARDI NIKI

Graphene Based Nanocomposite Electrodes for High Energy Density Supercapacitors

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Nanofunctional and Nanocomposite Laboratory
Institute of Nanoscience and Nanotechnology

Scientific Mentor:
Christos Trapalis

PLEIONE
ENERGY
re-think energy!

Company Mentor:
Antonios Vavouliotis
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The project aims in developing graphene nanocomposites with enhanced electrochemical performance that can be used in supercapacitors. Electrical double layer capacitors (EDLCs), like carbon materials, and pseudocapacitors usually function together in a supercapacitor. Graphene consists of a single sheet of carbon atoms that when they are rolled into tubes, they form Carbon Nanotubes (CNTs) with high tensile strength. The dispersion of carbon nanomaterials is critical for the development of good nanocomposites, as serious agglomeration usually occurs. Fine, stable, aqueous dispersions have been produced by graphene and CNTs using the aid of a surfactant. Iron oxide nanowires have been synthesised in order to be used as pseudocapacitors. The combination of graphene, CNTs and nanowires improves the electrode performance, as graphene acts as a bridge in the empty space between the nanowires and increases the surface area; whereas the additives impede graphene sheets from restacking and create conductive interconnections between the individual sheets.
1D fibers have been spinned using a home-made system that was built. Different coagulation baths have been used and the resulting graphene fibers have been used as electrodes for solid state, flexible supercapacitors. 2D thin films have been fabricated by electrodepositing graphene and CNTs onto copper and stainless steel. Electrodeposition consists of the electrophoretic motion of charged colloidal particles in a suspension that migrate and form a film at the electrode, under an applied electric field. Hybrid supercapacitors have been fabricated by this one-step deposition method that is a low-cost technique that does not require any heating or sintering.

BAMPATSIKOS MICHAIL

Management of Healthcare Data and Intellectual Property in Participatory Creativity using Blockchains

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Integrated Systems Laboratory
Institute of Informatics & Telecommunications

Scientific Mentor:
Stelios C.A. Thomopoulos

EXODUS

Company Mentor:
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The initial objectives of the project were to explore the application of blockchain to the management of Electronic Health Records and Intellectual Property. Currently the research project in question explores the use of blockchain to enhance security of IoT enabled Medical devices against Cyber threats. To this end a publication is underway due to be submitted on August. It was decided to narrow down the scope of the project to the sector of Healthcare due to the fact that it will have a greater impact on social welfare. After careful consideration it was decided to longer carry out research on using blockchain for Intellectual Property management due to a variety of legal considerations implications that may arise.

Besides those mentioned above, a blockchain based information system that manages Electronic Health Records has been developed project in the Ethereum solidity language according to the initial objectives of the. This system is constantly enriched with new features and functions and its development was one of the initial objectives of the project. The management and access to Health Records is performed through smart contracts.

Finally, the candidate participated in the authoring of two research proposals. The first was concerned with using blockchain to assist in managing cultural heritage artifacts, while the second dealt with using blockchain to reinforce cyber security of Electronic health records. The authoring of the latter was largely coordinated by the candidate.
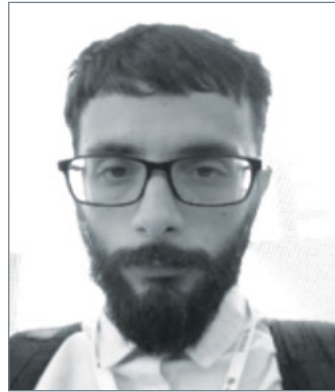
Conferences

- 12th Panhellenic Scientific Conference of Chemical Engineering, Athens, Greece, May 2019
- Researcher's Night, NCSR Demokritos, Athens, Greece, October 2018

BARMPAKOS DIMITRIS

A Multi Parametric Measurement and Control System Implemented on Flexible Substrates with Printed Technologies

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Energy harvesting
and autonomous
sensors laboratory
**Institute of Nanoscience
and Nanotechnology**

Scientific Mentor:
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Company Mentor:
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The project is progressing according to the technical program. Research has been performed regarding state of the art for printed sensors and sensors on flexible substrate and materials and geometries have been decided. Sensors and devices have been fabricated and evaluated for different use cases.

More specifically, theoretical background – requirements (WP1) has been completed. A study of each sensor, alongside with state of the art and device requirements definition have been documented. For design and fabrication of sensing elements (WP2), results from WP1 for material and geometry selection were utilized for humidity, temperature, strain and flow sensors. A parametric study and prototyping yielded a set of inkjet-printed AgNP and PEDOT:PSS humidity, temperature and compressive and tensile strain sensors, as initially planned for the 2nd quarter of the second year. A 2D flow sensor on flexible substrate was also fabricated; this sensor is of high importance for applications in harsh environments, while allowing for installation in non-planar surfaces. Modelling of the flow sensor incorporated a neural network for further describing its response to flow vector, accurately extracting both flow rate and angle of attack. This sensor finds direct application to flow sensing problems described in the initial proposal. All aforementioned sensors are currently being further evaluated for WP3, Evaluation of Sensing Elements; additionally, a relationship between PEDOT:PSS Seebeck coefficient and Carbon Quantum Dots as fillers for custom inkjet inks has been identified and investigated, for more efficient inkjet-printed thermoelectric generators on Kapton substrate.
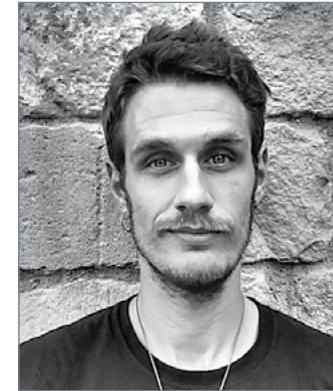
CHAITOGLOU STEFANOS

Graphene Based Hybrid Composites for Technology Applications

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Epitaxy and Surface
Science Laboratory
**Institute of of Nanoscience
and Nanotechnology**

Scientific Mentor:
Athanasios Dimoulas

Company Mentor:
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We have put a lot of effort on the research regarding Mo2C/graphene heterostructures. We have investigated the properties of this class of heterostructures as catalysts on the hydrogen evolution reaction, demonstrating the beneficial role of graphene on the catalytic activity of Mo2C films. Also, we were the first to report the heterostructure growth on liquid copper based alloys, at reduced temperatures, via chemical vapor deposition. Lately, we have studied the enhanced catalytic activity of this heterostructure when reversing its vertical order. The above work has produced two articles in peer-reviewed journal, while a third is under revision.

In addition, we have achieve the growth of 4-inch single layer graphene films on copper substrates, via chemical vapor deposition. These films are transferred on Thermoplastic polyurethane (TPU) films, to reduce the permeability of the second on He gas. For the above purpose, we have developed a transfer methodology to enable the transfer of graphene films on soft TPU films, via the assistance of a thermal release tape as support film.

Conferences
- EUROSENSORS 2018, Graz, Austria, 2018
- TRANSDUCERS 2019, Berlin, Germany, 2019

Publications
- A Disposable Inkjet-Printed Humidity and Temperature Sensor Fabricated on Paper. Multidisciplinary Digital Publishing Institute Proceedings Vol. 2, No. 13, p. 977, 2018.
- Enhancement Of Pedot:Pss Seebek Coefficient Using Carbon-Quantum-Dot-Based Nanocomposite Materials: Application To Inkjet Printing On Flexible Substrate, TRANSDUCERS 2019 Proceedings, IEEE Xplore, 2019.

Conferences
- Graphene 2019, Rome, Italy

Publications
- Direct vs reverse vertical 2-dimensional Mo2C/graphene heterostructures for enhanced hydrogen evolution reaction electrocatalysis, under revision, Inter. J. of Hydrogen Ener.
- Very large remanent polarization in ferroelectric Hf1-xZrxO2 grown on Ge substrates by plasma assisted atomic oxygen deposition Appl. Phys. Lett. 114 (2019) 112901 (I.F. 3.495)
- Mo2C/graphene heterostructures: low temperature chemical vapor deposition on liquid bimetallic Sn–Cu and hydrogen evolution reaction electrocatalytic properties Nanotechnology 30 (2019) 125401 (I.F. 3.404)
- Insight and control of the chemical vapor deposition growth parameters and morphological characteristics of graphene/Mo2C heterostructures over liquid catalyst Journal of Crystal Growth 495 (2018) 46–53 (I.F. 1.742)

CHALEVAS ELEFTHERIOS

Nature loaded Targeted Nanoparticles for Postate Cancer Therapy

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Biology Laboratory
Institute of Biosciences and Applications

Scientific Mentor:
Marina Sagnou

Biohellenika
ΕΤΑΙΡΕΙΑ ΒΙΟΤΕΧΝΟΛΟΓΙΑΣ

Company Mentor:
Koliakos Georgios
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In an effort to develop novel, multifunctional pharmaceutical nanomaterials with enhanced bioavailability and targeted antitumor activity against prostate cancer we have: a) synthesized PSMA inhibitors of the urea type, b) synthesized amino-terminated (full-generation) PAMAM dendrimers via the convergent and divergent synthetic methods, c)synthesized PEG6K-G4-OH via the general polycondensation procedure between Bis-MPA and PEG, d) synthesized Artemisinin (ART)-loaded (AHDSs) bis-MPA nano-matrices, e) investigated structural and textural properties of the newly synthesized materials by different and complementary characterization techniques such as elemental analysis, particle size distribution, z-potential, FT-IR, FESEM, HRTEM, and solution NMR, g) compared and evaluated the suitability of these matrices as potential nanocarriers regarding their drug loading, entrapment efficiency and release profile, and f) compared and evaluated the cytotoxicity potential of free and encapsulated ART in PC3 prostate cancer cells as well as in MCF-7 breast cancer cells and 3T3 murine healthy fibroblasts for comparison purposes. The incorporation of ART inside the HDSs interior was accomplished via the "molecular encapsulation process". FESEM and HRTEM images of the AHDS sample indicated the presence of globular NPs with sizes between 125-350 nm. The ζ-potential value of the obtained AHDSs was -3.71 ± 1.2 mV. The in situ ART entrapment efficiency was estimated to be 70.82%, whereas the loading capacity was 19.14%, respectively. The average ART release percentage during 48 h of study was 77.12%. Treatment of the PC3 prostate cancer cells and MCF-7 breast cancer cells for 24 h, 48 h and 72 h, revealed the non-toxic nature of the empty HDSs and the significantly enhanced cytotoxicity of AHDSs compared to free ART after 48 h and 72 h of treatment.

CHATZIGEORGIOU EMMANOUIL

Development of a Novel Characterization Method for New Types of Clinker Combining Scanning Electron Microscopy and X-Ray Powder Diffraction Techniques

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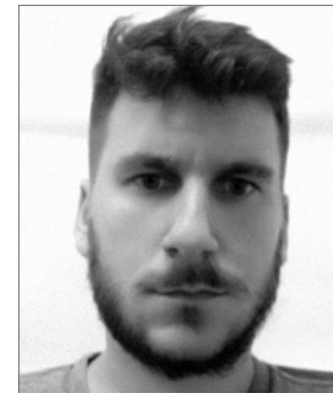
Electron Microscopy and Nanomaterials Laboratory
Institute of of Nanoscience and Nanotechnology

Scientific Mentor:
Nikos Boukos

TITAN

Company Mentor:
Marios Katsiotis
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The aim of this project is the development of a novel characterization method for new types of clinker using X-ray Powder Diffraction (XRD) Rietveld analysis and Scanning Electron Microscopy (SEM), Backscattered imaging as well as Energy Dispersive Spectroscopy mapping. The acquired data from those analyses will be combined providing a more precise and faster phase-quantification and characterization of clinker. The first objective of the project was the standardization of the sampling and sample preparation process. Towards this direction, a series of different sample preparation techniques for scanning electron microscopy and X-ray powder diffraction measurement have been performed revealing processes that minimize measurement artifacts. With the completion of the sample preparation standardization, high-accuracy measurement of the beam-current have been performed to calibrate the scanning electron microscope to ensure the repeatability of the measurements. In addition, comparison of multiple XRD devices measurements was performed. A series of Rietveld analysis software were also tested. Quantification of the amorphous phases was also achieved with an internal standard method. Additional information for clinker analysis was provided with X-ray fluorescent analysis of the samples.

The current status of the project is the development of a pixel-wise segmentation method for the backscattered images for clinker samples providing a course phase quantification. Finally, an optimization of the scanning electron backscattered image acquisition parameters is studied in order to maximize the information obtained and standardize the backscattered imaging process.

Conferences

- 9th Panhellenic Scientific Chemical Engineering Congress, Athens, Greece, 2019

CHIOTI G. AFRODITI

Development of an Alternative Method for the Reduction of Microbial Load in Anaerobic Digestion systems based on Photocatalysis

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Nanotechnology processes for solar energy conversion and environmental protection **Institute of Nanoscience and Nanotechnology**

Scientific Mentor:
Polycarpos Falaras

The TiO2 based photocatalyst has great potential for the disinfection of pathogens along with its well-known usefulness on various chemical pollutants. The disinfection property of TiO2 is primarily attributed to surface generation of reactive oxygen species as well as free metal ions formation. In this project, TiO2 based photocatalyst was used for the disinfection of the liquid digestate derived from anaerobic digestion systems i.e. biogas plant. It was found that disinfection of water contaminated with two bacterial strains (107 cfu/ml Escherichia coli and 106 cfu/ml Enterococcus faecalis) happened within the first 10 minutes (reduction of 3 logarithms) whereas total inactivation was achieved after 120 minutes (0.1 g/L P25, Degussa). Microbial revitalization experiments showed that the sample remained decontaminated. Then, chemical and microbiological profiles of liquid digestate of biogas plants were investigated. Based on findings, a synthetic effluent (20,000 mgO2/L Soluble COD) was generated to be used as a controlled substrate for the disinfection experiments. Photocatalysis was performed on the synthetic effluent inoculated with 107 cfu/ml E. coli at a 1:10 dilution. No inactivation of microorganisms was observed during the first 3 hours of photocatalysis. It was found that the sample of 0.5 g/L of P25 showed a reduction of 3 logs after 25 hours of photocatalysis. Undiluted samples required almost the triple time for disinfection (70 hours). Furthermore, temperature experiments show that temperatures above 40°C can lead to false positive results. Currently, we try to improve TiO2 disinfection capacity and overall performance through modifications, we explore novel mechanical arrangements while a method for the treatment of real digestate samples is optimized to scale up the procedure.

Company Mentor:
Themistoklis Sfetsas
www.q-lab.gr

Conferences
- Biogas and agricultural development: innovation, technologies, and prospects, Hellenic association of biogas producers, TIF-HELEXPO, Thessaloniki, Greece, 2019
- AgroCIRCLE- The implementation of the cyclical economy in agriculture and livestock farming, TIF-HELEXPO and Success Group, 11th Zootechnia, Thessaloniki, Greece, 2019
- Annual Hellenic Bioinformatics Conference H.bioinfo 11, Thessaloniki, Greece, 2018

Other distinctions
- Project NH3END- Innovative technologies to eliminate ammonia inhibition in anaerobic digestion in order to enhance methane production, RESEARCH-CREATE-INNOVATE, EPAnEK, NSRF 2014-2020

CHOLEVA EVANGELIA

Nanostructured adsorbents and membranes for biogas refining and upgrade via H2S capture and CO2/CH4 separation processes.

choleva.evangelia@gmail.com

Membranes and Materials for Environmental Separations Laboratory (MESL) **Institute of Nanoscience and Nanotechnology**

Scientific Mentor:
Evangelos Kouvelos

The aim of the project is the development of a new innovative and economically feasible process for the upgrading of the biogas to biomethane grade fuel through the removal of its two main pollutants, H2S and CO2. At the first stage new carbon-based adsorbents for the selective removal of hydrogen sulphide with adsorption capacity over 8.0 mmol H2S/g and diffusion coefficient higher than 10-6 cm2/s were produced. Potassium hydroxide modified activated carbon materials (12) were prepared and wet impregnation with Ionic liquids follows (9materials). The preparation parameters of all stages (synthetic process, treatment duration, temperatures, solvents, concentrations etc) has been studied in order to find the optimum synthetic conditions. The modified and impregnated materials have been characterized using liquid nitrogen porosimetry and performing H2S adsorption isotherms measurements at various temperatures (30-70oC) and pressures (1-10 bar) in order to determine the sorption capacity and the adsorption kinetics (Diffusivity). Comparing the results obtained it became clear that potassium hydroxide modification increases the surface area of the carbon material up to 60%. Furthermore, the ionic liquid impregnation of the activated carbon materials that follows fills the pores of the material and the surface area were decreased but still the pore width is adequate to favours the H2S adsorption and the sorption capacity is higher than 8.0 mmol H2S/g sorbent. Alternative adsorbents like amino functionalized carbon materials will be prepared in order to determine the most economically feasible synthetic process along with the suitable modified activated carbon.

Company Mentor:
Themistoklis Sfetsas
www.q-lab.gr

Conferences
- 12th National Conference in Chemical Engineering, Athens, Greece, 2019
- Zootechnia 11th International Fair for livestock and poultry, Information event for Biogas and agricultural development: Innovations technologies and prospects, Thessaloniki, Greece, 2019

Other distinctions
- «NH3END» (project code T1EDK-00406), Research project co-financed by the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH - CREATE - INNOVATE

CHRISTOFORIDIS CHRISTOFOROS

From Source to Tap Risk Assessment of Organic Pollutants in the Drinking Water Cycle of Athens

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Catalytic- Photocatalytic Processes and Environmental Analysis Laboratory
Institute of Nanoscience and Nanotechnology

Scientific Mentor:
Anastasia Hiskia

The objectives of this project in brief are: (a) to provide information on the presence and potential formation of selected emerging pollutants and their transformation products (TPs) throughout the water supply system of EYDAP S.A. (water sources, treatment, distribution network), (b) to elucidate the degradation pathways and produced TPs of selected emerging pollutants using advanced oxidation processes (AOPs) and finally (c) to provide a useful dataset of water quality data and register the main risks in the water supply system, enabling the initial formation of a Water Safety Plan (WSP) for organic pollutants and their TPs. So far the fellow has achieved to develop methods for the reliable determination of organic compounds in the water supply system of EYDAP, including: (a) markers of sewage pollution for surface waters, using SPE-GC-MS /MS and SPME-GC-MS/MS, (b) cyanotoxins (CTs) and related cyanobacterial metabolites in surface water, biomass and higher levels of the food chain (fish tissues), (c) taste & odour compounds (T&O) present in surface water, applying non-targeted and targeted screening using HS-SPME-GC-MS and (d) several disinfection by-products (Haloacetic Acids HAAs), using direct LC-MS/MS. The fellow has also studied the formation of TPs from representative compounds of emerging pollutants (cyanotoxins, T&O, dichlorophenol, etc), using AOPs such as γ-radiolysis, sonication, photocatalytic degradation using TiO_2 (suspension or immobilized surface), and the role of various individual reactive oxygen species (ROS) in the degradation mechanism. A database of organic compounds posing as potential risks to the water supply system has been created and is constantly being updated, incorporating mass spectral data and physicochemical properties of organic pollutants, including CTs and cyanobacterial metabolites, T&O, HAAs and oxidation products of selected pollutants.

ΕΥΔΑΠ

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DAGIOGLOU MARIA

Human Robot Collaboration Human Collaborator Representation for Robot Autonomous Decisions

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Scientific Mentor:
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Enabling humans and robots to collaborate frees human workers from doing heavy and repetitive tasks while allowing the execution of tasks that cannot be fully automated and necessitate human cognitive skills. Such collaboration has a high potential economic impact and is expected to play a catalytic role towards reshoring production, increasing the productivity of SMEs and meeting new market requirements and consumer needs.

The overall objective of the project is to advance robot capabilities that will allow for physical Human-Robot Collaboration (HRC) at shared workspaces without fences. As a first step towards safe and fluent collaboration, the robot must be able to perceive the pose and movements of the human collaborator. During the first year, the project experimented with existing human body recognition methods and evaluated their accuracy and efficiency in realistic environments. Moreover, it investigated how human position can be integrated in the robot motion planning and collision avoidance mechanisms to allow fluent interaction.

Moving forward, the project aims at developing methods that infer short-term human intentions based on their movements and thus predicting immediate-future actions. Using human representation and intention inference, the ultimate goal is to endorse robot with decision making capabilities that serve the purposes of safe and fluent collaboration.

SingularLogic

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Conferences

- 6th International Symposium on Marine and Freshwater Toxins Analysis, Baiona, Spain, 2017
- " SETAC Europe 28th Annual Meeting, Rome, Italy, 2018
- 11th international conference on toxic cyanobacteria", Krakow Poland, 2019
- 17th International Conference on Chemistry and the Environment ICCE 2019, Thessaloniki, Greece, 2019
- 6th Environmental applications of advanced oxidation processes EAAOP-6, Portoroz Slovenia, 2019.

Other distinctions

- EDBM B' Cycle «Young scientists support grant – Study of anticancer drug accumulation in intervertebral discs and their effect in cell ageing» NCSR"Demokritos"-Institute of Biosciences and Applications

DAVVETAS ATHANASIOS

Combination of Diverse Types of Data for Analytics in Insurance and Legal Contexts

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Athanasios Davvetas has studied fundamental definitions and concepts in the areas of Probability Theory, Statistics and Machine Learning, which are directly related to the field of study of his thesis (deep learning). Furthermore, he studied research methods concerning the collection and utilisation of results from experiments, writing practices, as well as organising and presenting said results in scientific papers. He conducted a study of relevant literature on neural networks, which are fundamental for the implementation of his working hypothesis. In addition, a literature study was conducted on combining heterogeneous data and their utilisation by neural networks, as well as, combining different relation database schemas (schema matching). By studying the relevant literature, he concluded to his working hypothesis "External heterogeneous data evidence improves deep representations", which evaluated experimentally. He designed a deep learning method of learning representations according to external categorical evidence, utilised to improve a primary task. His proposed method called "Evidence Transfer" has been evaluated using text and image datasets with the primary task of learning representations for clustering, while introducing multiple sources and various kinds of external evidence. Moreover, he provided a probabilistic interpretation of the effects of evidence transfer method on the latent representations by comparing his method to a well-received method of information theory called "Information Bottleneck". To verify the hypothesis of his probabilistic interpretation he conducted an empirical study on the latent feature relevance inspired by feature selection and feature ranking methods

Conferences
- International Joint Conference on Neural Networks (IJCNN), 2019, Bucharest, Hungary

Publications
- An Ontology for Describing Artificial Neural Network Evaluation, Topology and Training. International Journal of Metadata Semantics and Ontologies, 2019, 13, 179-190.
- The Effect of Evidence Transfer on Latent Feature Relevance for Clustering. Informatics 2019, 6, 17.

ELLINAS KOSMAS

Optimizing Razor Blades Using Plasma Processing

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The proposal had two major objectives organized in six (6) work packages.

- The first objective was to develop new manufacturable processes on existing coatings, or new plasma deposited or other coatings.
- The second objective was to develop new characterization methods for the coatings on the razor blade.

We already have some interesting results such as
1) Important knowledge was gained on the role of coating hydrophobicity in blade performance.
2) Superhydrophobic blades were prepared and evaluated.
3) An activation process has been developed and it is used to improve the adhesion of the coatings that are currently under development.
4) A new characterization method has been developed. It is a quick screening test done on stack of blades using contact angle measurements.

Conferences
- Superhydrophobicity and Wetting Symposium, Aalto University, Finland, 2018

Publications
- Superhydrophobic Fabrics with Mechanical Durability Prepared by a Two-Step Plasma Processing Method Coatings 8 (10), 351 (Featured article).

FETFATZIS PRODROMOS

AirSensis

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In this project the objective is the development of the AirSensis, an accurate, small, low cost smart sensor system having application packages, aiming to commercial product. The area of interest is the indoor air environment monitoring and control for home and work. AirSensis measures every minute a number of parameters namely time, place, temperature, humidity, pressure, carbon dioxide, carbon monoxide, PM10, PM2.5, PM2.5, VOCs, NO2, etc.

At this stage of development, AirSensis is a smart IoT device that interacts using Wi-Fi, mobile phone, on line platform that provides data visualisation. The on line data base of the system has been generated and the data analysis algorithm that will be used for further services or products, is now in the design phase. At this moment three working prototypes have been developed and another one is in progress for a patent. All of them have low cost, high stability, low uncertainty, tested in real work and home environmental conditions. The developed prototypes already are close to the level of TRL 6 and more options are designed for different commercial purposes.

We have participated at one European (2017) and one (2018) International Aerosol Conference, to the international exhibition 2018 TIF and to the 2nd Phase of the 9th Innovation & Technology Competition Competition " Four-day Bootcamp MATCH & DEVELOP A START-UP" of the National Bank of Greece - Athens University of Economics and Business in 2018, for disseminating our results and assist in attracting business partners towards full commercialization.

FLOROS IOANNIS

Next- generation Desalination membranes and hybrid systems (NEXT-DESAL)

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After one year, since the project started, progress has been achieved regarding the first two objectives, that is synthesizing (i) aligned carbon nanotubes (CNTs) membranes and (ii) double layered hollow fibre (HF) membranes. These membranes are intended to be used for desalination purposes in the nanofiltration (high pressure) and the forward osmosis (low pressure) system set-ups. For the first objective, multi-walled (CNTs) were attempted to be grown within the pores of ceramic (alumina) membranes both flat and tubular through the chemical vapour deposition (CVD) method.

The aim is to produce sub-nanometer pores that will, according to current research, increase multi-fold the water flow across the membranes. For the second objective, commercial HF membranes were modified with polymers, Dopamine and PEI, and filler material such as CNTs and/or GO. Research for these two objectives is still on-going and their water treatment performance with regard to desalination has yet to be evaluated. Additionally, hydrophobic (PVDF, PTFE) flat commercial membranes were modified with PVA (a hydrophilic polymer). These membranes have been successfully evaluated for their desalination performance in a membrane distillation set-up. Finally, schematics have been drawn up in order to gradually develop the pilot-laboratory scale desalination unit, which is the third objective of the project.

Conferences

- European Aerosol Conference 2017, Zurich, Switzerland
- 10th International Aerosol Conference 2018, Missouri, USA

Publications

- Annual Variability of Black Carbon Concentrations Originating from Biomass and Fossil Fuel Combustion for the Suburban Aerosol in Athens, Greece." 2017, Atmosphere 8, no. 12: 234.
- A European aerosol phenomenology-6: Scattering properties of atmospheric aerosol particles from 28 ACTRIS sites, Atmos. Chem. Phys. Discuss.,2017
- A new method to retrieve the real part of the equivalent refractive index of atmospheric aerosols, 2018, "Journal of Aerosol Science", 117, 54, 62

Conferences

- 12th PanHellenic Scientific Conference for Chemical Engineering, Athens, 2019

FOSTIRA FLORENTIA

Genetic Signatures Detected by Next Generation Sequencing on Ovarian Cancer Navigate Towards Precision Medicine

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Molecular Diagnostic Laboratory
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The purpose of our study is to identify damaging variants in genes that can lead to defects of DNA repair by homologous recombination (HR) in epithelial ovarian cancer (OC) patients, through which the ideal candidates for Poly (adenosine diphosphate–ribose) polymerase (PARP) inhibitor therapies, can be selected. In fact, the recent data of the Phase III clinical trial, SOLO1, suggest a remarkable impact on patient survival when these inhibitors come in the first line of treatment in newly diagnosed OC patients.

We have already completed the comprehensive analysis of genomic DNA from 578 epithelial OC patients for mutations in 94 genes that are involved in DNA repair. In addition to that, we have collected and assessed for somatic BRCA1 & BRCA2 mutations, 121 tumors from OC patients that had negative germline testing.

Overall, 25.4% of the patients tested, carried germline loss-of-function (LoF) variants, distributed in 18 genes namely, BRCA1, BRCA2, RAD51C, ATM, FANCL, CHEK2, FANCM, BRIP1, TP53, NBN, FANCA, RECQL4, MLH1, MSH2, MSH6, PMS2, ERCC2 and SLX4, of which the vast majority involves mutations in HR genes. Interestingly, beyond BRCA1/2 mutations, which accounted for 72.1% of the total LoF variants, RAD51C LoF variants were the most frequently identified. Subsequent tumor analysis resulted in the identification of damaging BRCA1/2 variants in a further 11.5% of the OC tested. This is an undergoing study, but the results to date are outstanding, with approximately one in three of OC patients tested prospect to be good candidates for therapies targeting defective DNA repair through HR.

FRAGOGEORGI EIRINI

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The Industrial Fellowship Postdoc program objectives focus on the promotion of new preclinical imaging products and the offer of unique joint imaging services, particular focusing in nanomedicine research provided by BIOEMTECH as well as on the development of a commercial radiolabelling kit for nanoparticles supplied by NCSR D. Research activities carried out so far, cover the following areas: (i) The extensive evaluation of BIOEMTECH'S small animal imaging systems (γ-eye and β-eye) through imaging studies on normal and/or pathological small animal models (mice) administered with SPECT (99mTc-labelled) and PET (18F-/68Ga-labelled) radiopharmaceuticals respectively, for enhancing their performance on hardware and software level. (ii) The creation of a price list regarding imaging services to be provided by BIOEMTECH and the establishment of imaging workflows in accordance to similar activity centers. (iii) The radiolabelling of hybrid magnetic nanoparticles (MNPs) validated in the frame of ongoing H2020 projects run by BIOEMTECH and the standardization of a ligand-mediated labelling methodology for MNPs taking into account the expertise of NCSR "D". The project is implemented according to the initial plan and all goals have been met. One small alteration in the sequence of activities has been made though. A highest priority was given to the evaluation of the β-eye system, since it became apparent that it was of a high marketing importance for the product to be finalized earlier than scheduled. Thus, β-eye was completed ahead of its deadline and the completion of the tomographic module of the γ-eye system was scheduled for the next semester.

Conferences
- American Association for Cancer Research 2019 – Atlanta – USA
- Balkan Gynaecological Pathology Oncology 2019 | Ioannina University Courses in Pathology - Ioannina – Greece

Other Distinctions
- DEcision Support system for Tumor radIogeNomics of the ovarY (DESTINY) project from the national call: "INVESTIGATE - CREATE - INNOVATE", budget 165.000 euro.

Conferences
- Greek conference of Biomedical Engineering and Technologies, Athens, Greece 2019
- 13th European Molecular Imaging Meeting (EMIM), San Sebastian, Spain, 2018
- 30th Annual Congress of the European Association of Nuclear Medicine, Wien, Austria, 2017

Publications
- Trimodal Nanoparticle Contrast Agent for CT, MRI and SPECT Imaging: Synthesis and Characterization of Radiolabeled Core/Shell Iron Oxide@Gold Nanoparticles" Chem. Lett. 2019, 48, 291–294
- In vivo imaging techniques for bone tissue engineering", ID JTE-Jan-19-0006, in press

GATSIOU CHRISTINA ANNA

Coarse Grained Modelling of Clay/ Polymer Nanocomposites

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Institute of Nanoscience and Nanotechnology

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SCIENOMICS
delivering science

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The polysaccharide-clay nanocomposite (PCN), is a class of materials with high scientific and industrial interest. PCN have a multitude of applications as fillers, packaging materials absorbers, medical implants and drug delivery materials etc. The study of their properties by means of molecular modeling techniques requires the access of large lengths and timescales and therefore the use of a coarser description level is necessary. The development of a tool that provides a link between the atomistic and coarser representations was essential in the study of PCN and was also one the primary objectives set by Scienomics.

Such a tool for systematic coarse-graining of atomistic systems has been developed and integrated in the software distributed by Scienomics (MAPS). The tool, called VOTCA (Versatile Object-0riented Toolkit for Coarse-graining Applications), is available as a plugin of the MAPS 4.3 program and implements established coarse-graining techniques, such as iterative Boltzmann inversion and force matching that can generate of CG models and force-fields for any given atomistic system.

With the use of the aforementioned methods, the construction of a CG representation for the composite materials of a PCN has been achieved. The PCN material that has been chosen for study contains starch, as the polysaccharide and kaolinite as the clay mineral. Based on atomistic simulations of starch and kaolinite, new CG force-fields have been calculated for the two systems. The remaining step is the coarse-grained study of the amylose-kaolinite system in order to observe its mechanical properties and swelling behaviour.

KADDAS PANAGIOTIS

DocCS: Document Classification & Semantic/Sentiment Analysis

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in Digital

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The current status of this work is strongly connected to the project's initial objectives. A semantic annotation tool for historical handwritten documents that facilitates the page segmentation process has been already developed and published as a conference paper. A document classification system based on deep learning and image processing techniques has been developed and already been embedded in the company's infrastructure. In the meantime, this work is being used as the initial source for a journal publication. Furthermore, research for systems relative to the semantic and sentiment analysis of textual information has been completed and the implementation of the respective system will follow.

Deep learning techniques are the backbone of all the systems mentioned above, fused with image processing and text mining algorithms. Finally, the developed systems are already being used for different projects of the company, saving over 30% of human resources per project, concerning the meta-data extraction , Optical Character Recognition (OCR) and quality control tasks. As mentioned before, a journal publication on the document classification problem will soon follow, alongside with the implementation of the semantic/sentiment analysis system.

Conferences

- 16th International Conference on Frontiers in Handwriting Recognition (ICFHR 2018), Niagara Falls, USA, 2018
- 3rd Digital Access to Textual Cultural Heritage (DATeCH 2019), Brussels, Belgium, 2019

Other distinctions

- American Airlines: Digitisation of 50k aircraft repair forms. This project consisted of automatic document classification, meta-data extraction through localization and OCR techniques.
- AB Basilopoulos: Automatic meta-data extraction from questionnaires (over 60k forms) using deep learning techniques.

KAKLIS DIMITRIOS

Routing Optimization in Maritime Industry: Coupling Data Mining with Machine Learning Algorithms in the Context of a Non-Convex Regulated Regression Estimated Problem

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The initial objectives / targets that were set for the first two years of the PhD process are presented below:

Year 1: Survey of the relevant literature to determine current trends regarding methodologies and data handling. It is critical that this survey will be informative regarding which types of ship-upgrades would constitute sound return on investment, an issue which will affect subsequent decisions.

Year 2: Study and implement innovative machine-learning models and algorithms to predict exergy maximization, aiming to push the boundaries of the operational and algorithmic state-of-the-art. Experimental evaluations will be compared to corresponding baselines. This study will also focus on the accuracy of the model to be implemented and its efficiency compared to the overall cost of the implementation.

Currently, a series of experiments conducted with industrial data provided by DANAOS, indicated the existence of a strong correlation between RPM of the engine and the overground speed V of the ship. In this connection, it was decided to investigate the possibility of developing a prediction method that is based on this 2D feature vector, namely (RPM(t),V(t)), which would enable the operator avoiding high-cost measurement investments as well as computational tools based on high-dimensional feature vectors.

Conferences
- DEAS2019 - 23nd International Database Engineering & Applications Symposium, Athens, Greece, 2019

KALFAKAKOU DESPOINA

Development and Optimization of Bioinformatics Tools for Cancer Predisposition Diagnosis

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Cancer genetics has become a crucial aspect in the practice of medical oncology, while the recently introduced Next Generation Sequencing (NGS) technology has paved the way to precision medicine. However, NGS brings new challenges in terms of data management and interpretation, which can be met with the use of bioinformatics. The current PhD project aims at the development and optimization of bioinformatics algorithms and tools for the efficient discovery of causative gene variants that predispose to specific cancer types and tumor DNA biomarkers that can be used for targeted treatment. The project addresses five major challenges: 1. Large-scale NGS data processing., 2. Interpretation of the functional impact of genomic variation., 3. Data translation aiming to a comprehensive and accurate mutation-phenotype association., 4. Integration of these discoveries to medical practice.

And 5. Development of a Greek population-specific cancer gene variant database. In the two first years of the Industrial Fellowship Program, the following have been achieved:
• The first Greek database for hereditary cancer is almost completed. CanVaS will host data that derive from genetic analyses of ~11,000 Greek individuals that have been diagnosed with different neoplastic conditions and have been genotyped for variants in 1-94 known cancer susceptibility genes.
• VarTrace, a fully configurable, highly parallelized, integrated pipeline for the analysis of FFPE tumor DNA sequencing data has been constructed.
• As part of the development of a National Registry for Peutz-Jeghers Syndrome (PJS), a database recording the mutation spectrum and the phenotypic features of PJS patients and a site (https://www.peutzjeghersgreece.org) have been designed.

Conferences
• Hellenic Bioinformatics 10, Heraklion, Greece, 2017 • Hellenic Bioinformatics 11, Thessaloniki, Greece, 2018 • European Conference on Computational Biology, Athens, Greece, 2018

Publications
• PALB2 c.2257C>T truncating variant is a Greek founder and is associated with high breast cancer risk, J. Hum. Genet., May 14, 2019 • Functional characterization of CHEK2 variants in a Saccharomyces cerevisiae system, Hum. Mutat., Mar 9, 2019 • Contribution of RAD51D germline mutations in breast and ovarian cancer in Greece, J. Hum Genet. 63 (11), 2018 • Germline deleterious mutations in genes other than BRCA2 are infrequent in male breast cancer, Breast Cancer Research and Treatment, 2018 • Genetic analysis and clinical description of Greek patients with Peutz-Jeghers syndrome: Creation of a National Registry, Cancer Genet. 220, 2017

Other distinctions
• Best Oral Presentation Award. Kalfakakou D, et al, Hellenic Bioinformatics 10, Heraklion, Greece, 2017
• Best Project Proposal Idea. Kalfakakou D, et al., Volos Summer School of Human Genetics, Volos, Greece, 2018

KATOPODIS THEODOROS

Assessing Climate Change Resilience in Hellenic Petroleum Facilities

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The main scope of this project is the establishment of a consolidated methodological approach that will determine the resilience of HELPE selected facilities against climate risks, through an innovative framework for supporting the HELPE Infrastructure's resilience to climate pressures. The overall methodology was built on the development of a process based analysis for the selected facilities, based on the analysis of its constituent assets and of the corresponding critical interconnected and interdependent processes in within oil infrastructure (OI) caused by climate hazards, and identifies the related impacts on the OI processes and performance. So far a classification of the OI and its assets/critical services in accordance with their design threshold and their interconnections, the direct and indirect impacts (as a result of climate hazards), and the study of the climate drivers and hazards has already been performed. A thorough analysis of existing literature review, design standards and operational parameters has already been completed, based on previous research at a global level, design standards and operational parameters of the climate impacts to the assets of the OI in order to identify the related Critical Infrastructures (CI) critical event parameters and CI exposure. Hence, a preliminary version of the workbook presenting the sensitivity matrix developed for HELPE facilities, as a part of the holistic CI risk assessment model pertaining to climate hazards was delivered. Main scope of this workbook is to determine the precise climate dependent causal relationship between CI assets, which comprises the basic modelling element for the determination of a risk propagation framework for CI. In that direction, one from the starting points of this methodological analysis has been the capturing, processing and visualization of climate data and related hazards, providing also a linkage between climate parameters/ hazards and oil industry's' sector, developing an OI hazard threshold matrix, containing CI related design thresholds, with the aim to define the oil sector exposure to climate risks.

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KOSMADAKIS GEORGE

Integrated Solutions for Low Temperature Waste Heat Recovery and Exploitation in Industrial Processes

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The core objective of the project is to develop advanced processes and integrated configurations for exploiting the industrial waste heat. Focus is given on low-temperature heat (below 100 oC), with the aim to increase energy efficiency. The project primarily deals with the development of high-temperature heat pumps for upgrading the waste heat. An advancement of this set-up for improving the system flexibility is to use a reversible unit for either heat-to-upgraded heat or heat-to-power, and thus conclude to a reversible (high-temperature) heat pump/organic Rankine cycle.

The work is conducted according to the initial scheduling. The potential for waste heat exploitation in EU industry has been finalized (Month 1-6), with the main results published in a journal paper (see next). This has been also expanded for the marine sector, after a request by the participating Company. The next activity concerned research on possible fluids and nanomaterials (nanorefrigerants) that can be used in heat pumps (Month 4-15), which has been completed successfully, leading to a preparation and submission of a journal paper (see next). The core work of this project is about the in-depth analysis of the high-temperature heat pump itself (Month 13-30), which is currently progressing with the first results already available.

The other main activities concern the: (1) investigation of the reversible heat pump/ORC unit (Month 25-39) with some first results to be presented in ORC2019 conference (see next), and (2) the detailed cost-benefit analysis with some preliminary cost analysis already included in all previous activities.

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Conferences
- 14th International Conference on Meteorology, Climatology and Atmospheric Physics, Alexandroupolis, Greece, 2018

Publications
- EU-CIRCLE methodological approach for assessing the resilience of the interconnected critical infrastructures of the virtual city scenario to climate change, Energetika 64 (1), 2018
- Assessment of climate change impacts on wind resource characteristics and wind energy potential in Greece, Journal of Renewable and Sustainable Energy (entered the editorial process), 2019
- A review of oil sector impacts to climate change, Infrastructures - Open Access Journal (entered the editorial process), 2019

Conferences
- 5th International Seminar on ORC Power Systems (ORC2019), Athens, September 2019

Publications
- Estimating the potential of industrial (high-temperature) heat pumps for exploiting waste heat in EU industries. Applied Thermal Engineering 2019;156:287-298.

Other distinctions
- H2020 Grant for the project Renewables for Clean Energy Buildings in a Future Power System

KOTSILITIS SARANTIS

Hardware Accelerated Energy Disaggregation for Energy Efficiency and Predictive Maintenance Applications

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System Reliability and Industrial Safety Laboratory
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This project aims to develop novel tools for energy disaggregation and monitoring of device health status. These tools will perform analysis of complex energy load time-series using real-time pattern recognition/matchmaking and hardware accelerated algorithms, and will transmit the recognised events to a main server.

During its first 20 months, the project has successfully achieved the milestones set in the proposal. Following the initial training of the Fellow -also involving the review of cutting edge methodologies and current trends-, a prototype was developed for High frequency sampling of energy data. Deployment of the prototype to a commercial building has so far provided over 1Tb of energy consumption and ground truth data. In parallel, the Fellow analysed publicly available datasets using tailor-made neural network algorithms for energy disaggregation and supervised approaches for device classification. The work proceeded to signal processing methods, to analyse the different open data and the expanding dataset of the project. Current work involves fine-tuning the algorithms and deploying them on FPGA devices, to achieve hardware acceleration and develop a first version of the FPGA implementation in the coming months. The project team is now actively pursuing industrial pilots to deploy the sampling devices, and to collect a large and heterogeneous set of energy load data from wind turbine, chemical plant, commercial building etc. machinery. During the next couple of years, these data will support the design, development and implementation of networks of distributed agents and their collective logic, to enable predictive maintenance applications under Industry 4.0.

Conferences
- European Safety and RELiability (ESREL) Conference, Trondheim, Norway, 2018
- International Conference on Industrial Internet of Things and Smart Manufacturing (IoTsm), London, United Kingdom, 2018
- European Safety and RELiability (ESREL) Conference, Hannover, Germany, 2019

Publications
- Energy efficiency and predictive maintenance applications using smart energy measuring devices. In "Safety and Reliability–Safe Societies in a Changing World" (pp. 987-994). CRC Press.
- Distributed edge computing paradigm with dedicated devices for energy efficiency and predictive maintenance applications. In "Industrial Internet of Things and Smart Manufacturing", Springer Series on Lecture Notes on Data Engineering and Communications Technologies (NDECT), in press (ISBN: 978-1-912532-06-3)

KOYMPOURI DIMITRA

Development of Novel Cement Clinkers with Low Carbon Footprint for Industrial Production

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The purpose of the current project is to investigate the production of novel, eco-friendly cement clinkers, with equivalent or improved service (performance) properties compared to the conventional Portland (OPC). Towards this direction, the design, production and hydration mechanism of Belite Calcium SulfoAluminate cement clinker (BCSA), was studied. More specific and in accordance with the objectives of the project:

- The design of raw mixes for the production of different types of BCSA cement clinkers, was implemented. For that purpose the evaluation of a variety natural raw materials as well as the comprehensive assessment on the valorisation of selected solid by-products as alternative raw materials, carried out.
- The production parameters of the clinker (firing temperature and time, phase changes etc.) were established and linked with the mineralogy development and quality of the produced BCSA clinker, main parameters for the performance of the cement.
- In the frame of applied research for the industrial scale production of BCSA cement, the abovementioned scientific results provided the essential information for the prediction of the high temperature phases in relation with mineralogy of raw materials and firing conditions and contributed to the 1st industrial production trial of eco-friendly BCSA cement by TITAN S.A.
- Furthermore, initial studies on the hydration mechanism of the laboratory produced cement and its physic/mechanical properties have been carried out.
- Finally, up to now have been achieved a strong reinforcement of the bonds and interaction between academia and industry partners by combining the complementary qualities of both sectors.

Conferences
- 1st International Conference on Innovation in Low-Carbon Cement and Concrete Technology, London, UK, June 2019
- 12th Hellenic Scientific Conference of Chemical Engineering, Athens, Greece, 2019

Other Distinctions
- Participation at the 1st Industrial trial for production of eco-friendly Belite Calcium Sulfoaluminate cement by TITAN S.A. (April 2018)

KYLAFIS GEORGIOS

Particle Engineering for Pulmonary Drug Delivery

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Environmental Radioactivity
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**Institute of Nuclear
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The main objective of this project is to develop and test a novel aerosol drug-delivery approach using combination drug-excipient submicrometer particles which may offer high deposition efficiency in the lungs and minimal losses in the mouth-throat region. The hygroscopic behaviour of aerosols has been studied widely, perhaps most extensively by atmospheric physicists and industrial hygienists, who examined the behaviour of pollutants following inhalation. Aerosol growth can be achieved using a method known as excipient enhanced growth (EEG).

The first task of this project will aim at investigating the effects of EEG formulation variables (excipient type, drug-excipient ratio, drug type and aerosol generation device) on the aerosol hygroscopic growth characteristics of combination drug and excipient sub-micrometer aerosols from solution formulations using online particle sizing experiments.

To this direction, a Hygroscopic Tandem Differential Mobility Analyser (HTDMA), designed to measure size-resolved aerosol hygroscopic properties, is currently under installation based on an existed configuration which is going to be improved in order to produce high quality experimental data. At the same time, the installation of an experimental setup based on a Berner cascade impactor has been completed and is ready for the conduction of mass particle sizing experiments on drug aerosols of specific synthesis indicated by our partners in Chiesi Ltd (UK). Reference drugs have already been sent to our lab from our partners.

LABROPOULOS ANASTASIOS

Novel Hybrid Membrane System for Capture of Carbon Dioxide

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Membranes & Materials
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The project has been modified at the request of the participating company (SUK Hellas Ltd), which was formally submitted for approval to NCSR "Demokritos" on February 14, 2018. NCSRD re-sent the proposal for evaluation and the modified proposal was finally approved on September 2018. The project has undergone a drastic alteration in content, in what concerns the objectives, work packages, deliverables and time schedule. However, one of the two the main scopes of the program, which pertain to carbon dioxide capture from flue gas by using composite nanostructured membranes and materials, remained broadly the same as the previous content of the project. The new title of the project is "Novel Hybrid Membrane system for Capture of Carbon Dioxide (CO2-HMC)". The modified workplan includes new objectives which are related to development and characterization of ZIF/GO and ZIF/MWCNTs nanocomposite adsorbents and nanofillers, evaluation of their CO2 absorption capacity, development and testing of novel GO/ZIF/Polyethyleneimine and MWCNTs/Polyethyleneimine hollow fiber Mixed Matrix Membranes (MMMs) for CO2 separation from flue gas, testing of the developed MMMs utilizing a lab-scale hybrid VTSA/membrane process unit. Mixed matrix membranes based on commercial and in-house prepared polymers and composite nanofillers has been performed and tested during the second year of the project. It is noted that the decision of the company and the company's supervisor was that I should be engaged and deal mostly with a European H2020 project in which the company participates as an industrial partner and WP leader.

Conferences
- 2nd International Conference on Membrane Science and Technology, London, UK, 2018

Other Distinctions
- Effect of a cyclic heating process on the CO2/N2 separation performance and structure of a ceramic nanoporous membrane supporting the ionic liquid 1-methyl-3-octylimidazolium tricyanomethanide", Sep. Purif. Technol. 200 (2018) 11-22.

MAKRIS DIMITRIOS

Optimization of Dosimetry for Modern Radiotherapy Techniques for Safer and More Effective Radiotherapy of Brain Tumor

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Environmental Radioactivity Laboratory (ERL)
Institute of Nuclear and Radiological Sciences & Technology, Energy and Safety

Scientific Mentor:
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The work so far has been organized in 7 workpackages as following:
(1) Gel dosimetry refinement,
(2) phantoms construction and geometric accuracy evaluation,
(3) small-photon field dosimetry,
(4) TCP-NTCP calculations,
(5) personalized-PTPV, GNPs role evaluation,
(6) inter-comparison between experimental data and data from Monte Carlo simulations and general management
(7) results dissemination. According to time-plan so far the first three and fiftht workpackages are completed and that resulted in the publication of my basic scientific research for my PhD thesis.

We are currently in the process of inter-comparing our experimental data with Monte Carlo simulations. We are also planning an expertiment for the GNPs role evaluation that will be completed within the next six months.

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MAVROIDI BARBARA

Development of a Radiodiagnostic Agent for Breast Cancer

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Scientific Mentor:
Maria Pelecanou

The encouraging data obtained through the in vitro and in vivo assessment of the rhenium complexes of 2-(4´-aminophenyl)benzothiazole derivatives through the uptake/cytotoxicity/mechanistic studies against a series of cancer cell lines and healthy cells, along with biodistribution studies in mice not only revealed the anticipated cell selectivity but also indicated their potential to serve as radiodiagnostic agents for breast cancer.

Based on these results, the MCF-7 adenocarcinoma breast cancer cell line was identified as the line with the best properties (high and specific uptake of the complexes along with induction of cell cycle arrest and apoptosis possibly due to over-production of ROS) in order to proceed in the generation of xenografts in SCID mice.

The biodistribution results so far in tumor bearing mice indicate that the corresponding 99mTc complexes selectively accumulate in MCF-7 breast tumors, and tumor imaging experiments with a γ-camera are currently in progress. As it is obvious from the experimental work presented the project is running according to the time schedule with no deviations from the work planned and no major problems, while two out of the three milestones have already been successfully reached. Overall, the results up to now are very promising for the completion of the project, as described in the submitted proposal.

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Conferences
- ICARO 2, 2017 in Vienna
- ASTRO 2017 in San Diego, USA
- ESTRO 2018 in Barcelona, Spain
- ASTRO 2018 in San Antonio, USA
- ESTRO 2019 in Milan, Italy

Publications
- Gel dosimetry for three dimensional proton range measurements in anthropomorphic geometries" Zeitschrift für Medizinische Physik, In press, 2018
- Personalized End-to-End QA in Cranial SRS: Evaluation of the Phantom-to-Patient Dosimetric Equivalency of a 3D Printed Phantom using Film Dosimetry" Int. Jour. Rad. Oncol. Biol. Phys., 102(3), e485-e486, 2018
- A 3D polymer gel dosimeter coupled to a patient-specific anthropomorphic phantom for proton therapy" Radiotherapy and Oncology, 123(S1), s432-s433, 2017

Conferences
- 3rd International edition of the symposium on Technetium and Other Radiometals in Chemistry and Medicine (TERACHEM 2018), Bressanone, Italy, 2018
- 69th Panhellenic Conference of the Hellenic Society of Biochemistry and Molecular Biology (EEBMB2018), Larissa, Greece, 2018

Publications
- Remarkable brain penetration of cyclopentadienyl M(CO)3+ (M = 99mTc, Re) derivatives of benzothiazole and benzimidazole paves the way for their application as diagnostic, with Single Photon Emission Computed Tomography (SPECT), and therapeutic agents for Alzheimer's disease. Journal of Medicinal Chemistry, 2019. 62: p. 2638-2650

Patents
- Tricarbonyl complexes of transition metals with benzo-heterocyclic derivatives of the cyclopentadienyl anion with high penetration of the blood-brain barrier for application in diagnosis and therapy of diseases of the CNS" OBI, No 20180100128, 22-3-18, PCT/EP2019/057235

MAVROKEFALOU GEORGIA

Study on the Relation of Radioactive Pollution and Satellite Observations of Marine Parameters and Comparative Analysis on Geographic Information System

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Environmental Radioactivity Laboratory
Institute of Nuclear and Radiological Sciences & Technology, Energy and Safety

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Within the framework of the project, the following procedures have been performed:

- Sea water sampling preparation (Copper Ferrocyanide filters creation, construction of a metal table-top sampler)
- Sea water samplings in Corinth Gulf and Lemnos Island.
- Radiochemical analyses for 137Cs in sea water samples using the Ammonium Phosphomolybdate ion-exchange method and 134Cs as carrier and yield tracer. The samples were from Souda Bay, Corinth Gulf and Lemnos. Also Copper Ferrocyanide filters, taken from Corinth Gulf and Lemnos were treated in the laboratory.
- Gamma spectrometry measurements are performed using a Canberra High Purity Germanium detector (HPGe) with an efficiency of 90% relative to a 3" X 3" NaI(Tl) detector. The resolution is 2.1 keV at the 1.33 MeV photopeak of 60Co and it is coupled to an 8k Multi Channel Analyser. Efficiency calibration of the detector has been achieved by the use of a Multi Gamma Source (with the isotopes being evenly distributed in a pillbox type container using a resin matrix substrate) covering the whole energy range from 60 keV to 1840 keV. Measurements are performed using exactly the same geometry settings.
- Obtainment of satellite images from ESA (SMOS and Sentinel-3) and NASA (TERRA, AQUA, SNPP-VIIRS, AVHRR and SeaWiFS). Also CMEMS model products were used. Then the marine parameters SST, SSS, Chlor_A, PIC, POC, iPAR, PAR, MLD, NO3, PO4, PHYC, O2, SPCO2 and pH were retrieved using SNAP and SeaDAS software.
- Regression analyses (linear, binomial, MLR) between 137Cs activity concentrations and remote sensing marine data (1993-2018) using Origin software. The regressions were performed by region, per year and per period (cold-warm).

MEGADOUKA DIMITRA

Novel Phytomining Production of Advanced Metal Nanoparticles Graphene Catalytic Membranes

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Nanofunctional and Nanocomposites Materials Laboratory
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Based on the submitted proposal, the following tasks have been achieved until now:
- Intercalation of GO was achieved, using amines, in order to create nanofiltration membranes for ion separation and other uses. Intercalation of GO was one of the main targets, in order to find an easy and controlled method to enlarge the interlayer distance of the GO layers. The permeability and sorption capacity will be examined.
- Also the functionalization of GO sheets with copper using solvothermal methods has being tested. Copper acetate and copper chloride were used as Cu2+ sources. Various forms of GO were tested at various conditions in order to achieve higher concentration of Cu.
- Reduction of GO was used as another method for easier production of graphene. Four reducing agents were successfully used in various temperatures and duration.
- An effort has been made to directly functionalize graphite with a simple and cost effective method, as an alternative solution to graphene functionalization.
- Finally, one step electrochemical exfoliation of graphite has been applied using two different ionic liquids, in different ratios and various voltages in order to produce graphene. The properties of the materials produced are under examination and more experiments will be conducted.

So far, over 100 samples related to work packages have been prepared. The preparation and submission of two EU programs H2020 has been completed. The first paper for dissemination of the results is being prepared and it is estimated to be ready for submission on July 2019.

Conferences

- 27th Hellenic Nuclear Physics Symposium (HNPS 2018) held on Athens, Greece, 2018
- ESA Living Planet Symposium 2019 (LPS2019) held on Milan, Italy, 2019
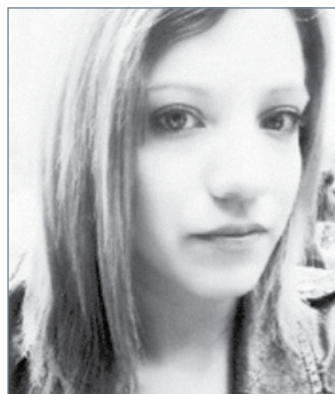
MICHAILIDI ELISAVET

Study of the Effect of Nanobubbles Enhanced Water Solutions on the Cleaning of Stainless Steel and Ceramic Surfaces from Oil Based Contaminants

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Materials and Membranes
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The purpose of this project is to elucidate the effects of nanobubble suspensions, produced with prototype NB generators, and study the nanobubble formation, size distribution, coalescence, stability and dynamic behavior. Consequently, new knowledge will be gained regarding the properties of nanobubbles and their applications on cleaning and preventing depositions on stainless steel (SS) and ceramic surfaces.

Dynamic Light Scattering (DLS) and ζ-potential measurements were conducted in order to find the optimal process conditions regarding the desired size distribution and stability. The studied parameters were the gas flow, temperature and working time. Also, the effect of salinity, gas type and pH was examined. Subsequently, experiments on the wetting properties of bulk NBs suspensions were carried out; the Drop Shape Analysis (DSA) technique was employed to determine the contact angle (CA) of NBs@air and NBs@O2 on standard glass surfaces. The results were promising as it was observed that in both cases, the CA was significantly reduced in comparison with H_2O.

It has been shown that micro-nanobubbles are able to generate free radicals during their collapse, in the absence of a dynamic stimuli. Electron Paramagnetic Resonance (EPR) measurements confirmed that NBs@air and NBs@O2, produce small amounts of free radicals. This finding, is considered important as free radicals are known to be involved in many biological processes as well as in cleaning mechanisms.

NIAKOULA AFRODITI

Adhesive Polymeric Materials and Non-Destructive Characterization Methods for Abrasive Coatings

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Adhesive formulations are of fundamental importance for a wide range of industries from packaging to electronics. Product development through successful chemical formulations is a challenging task since these formulations incorporate a number of components of varying chemical nature that interact in various ways determining the final properties. Main objective of this project is the development of advanced resin formulations suitable for application in multilayer structures encountered in film abrasives. Significant work on this objective has already been accomplished via new formulations and processes, handling both scientific and engineering challenges allowing maximization of adhesion to plastic substrate. Specific properties requirements -inherent to the production line of the company- such as tack time, curing temperature and time, viscosity, and film forming capability by rolling coating system are being addressed through formulation adjustments. Binders, curing agents, fillers, chain extenders and additives including dispersants, wetting agents, defoamers, etc., were studied in order to modify effectively the desired properties. Waterborne systems based on phenolic, epoxy and melamine formulations were evaluated and tested in production. Results revealed that selected formulations are promising for incorporation in the production of film abrasives for a wide range of grain sizes. An improved insight into the factors controlling formulation properties has been acquired that will support the further optimization of formulations. The project is further aiming to the development of improved characterization methodologies that will add valuable knowledge for formulation optimization. Scanning electron microscopy (SEM) and Raman spectroscopy have been selected and first results have been obtained for advancing characterization.

Conferences
- Conference on Advances in Chemistry (ACAC 2018), Athens 31/10-2/11/2018.
- IC4N, Corfu, Greece, 2018

Publications
- Fundamentals and Applications of Nanobubbles", Book Chapter, Advanced Low-Cost Separation Techniques in Interface Science, in press, 2019, Elsevier.

Other Distinctions
- Best Oral Presentation Award "Evaluation of NBs@air and NBs@O2 effect on biological systems: Study of ROS-induced cell toxicity", Athens Conference on Advances in Chemistry (ACAC 2018), Athens

Conferences
- European Coatings Show & Conference, Nuremberg, Germany, 2019

NIKOLAKOPOULOU AGGELIKI

Development and Validation of Radiation Cytogenetic Assays to Predict Individual Radiosensitivity and Optimize Personalized Radiation Therapy

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Radioactive Materials Management Laboratory
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Although rapid technological advances have led to a more precise delivery of radiation dose and to a decreased risk of side effects, there is still a significant need for personalized treatment to be achieved through the development of predictive tools that may guide therapy decisions. Indeed, the identification of patients that are sensitive or resistant to RT could be used as a basis for tuning the appropriate therapeutic radiation dose for individual patients, optimizing thus the therapeutic gain in cancer treatment. The aim of this study is to validate the G2-chromosomal radiosensitivity assay (G2-assay) and to investigate the potential of combining radiation therapy with G2/M-checkpoint abrogators in vitro, e.g. caffeine or hyperthermia, to overcome radiation resistance of tumours and examine the molecular mechanisms involved. During the reporting period G2-chromosomal radiosensitivity of peripheral blood lymphocytes from 13 patients with a diverse range of cancers and 5 healthy donors was estimated by means of the G2- assay. The Individual Radiosensitivity Parameter (IRP) was calculated representing the difference between the two yields of chromatid breaks obtained, after in vitro irradiation of cultured lymphocytes during G2- to M-phase transition, with and without inactivation of G2-checkpoint by means of caffeine and hyperthermia. The radiosensitizing potential of G2/M checkpoint inhibitors was also examined. In addition, the efficiency of advanced radiotherapy techniques such as VMAT and IMRT delivered by Elektra linear accelerators, using phantoms in conjunction with conventional as well as advanced cytogenetic techniques including Premature Chromosome Condensation is currently investigated.

Conferences
- ICRR 2019 16th International Congress of Radiation Research, Manchester, UK
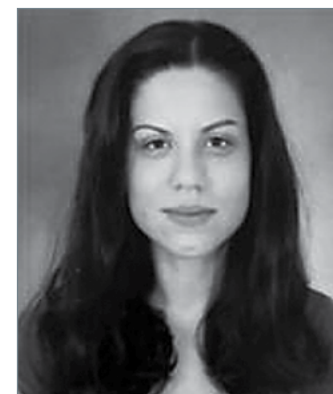
NTALLA ELENI

Development of a Time and Cost Effective Technology for Radiological Characterization/ Segregation of NORM Waste

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Radioactive Materials Management Laboratory
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The first part of the PhD was mainly focused on the literature review. The properties of the candidate detector LaBr3(Ce) (linearity, internal background, resolution, efficiency and temperature dependence) were investigated and the detector proved to be appropriate for the specific application. The detector has better energy resolution compared to other scintillators (< 3% at 137Cs), there is no need for nitrogen cooling and has better efficiency compared to HPGe detectors. NORM nuclides were studied (γ-spectrometry, applications and legislation). Also, destructive and non-destructive characterization methods for NORM waste in industrial activities were examined (γ-spectrometry, XRD/ XRF techniques and Monte Carlo simulation techniques). The second part of the thesis was dedicated to the calibration of the scintillation detector LaBr3(Ce). Energy and resolution calibration was carried out experimentally by using several point sources. Regarding the efficiency calibration, a semi-empirical calibration method for NORM samples measurement was developed based on a combination of experimental gamma spectrometry measurements and MCNPX simulations by using four reference multi-nuclide volume sources made of epoxy material of different densities (0.5, 0.9, 1.5 and 2.0 g/cc). The aim of this work is to provide us with full energy peak efficiency calibration curves in a wide photon energy range which is of particular importance when selected photon energies of 234Th, 214Pb, 214Bi, 228Ac, 208Tl and 226Ra are to be analyzed for accurate quantitative determination of the natural radionuclides. Furthermore, factors that affect NORM samples analysis, such as LaBr3(Ce) internal background and peak interferences, were considered. Nominal NORM samples originating from oil industries as well as phosphorite reference samples were analyzed for evaluation of the technique.

Conferences
- 27th Annual Symposium of the HNPS, Athens, Greece, 2018
- 28th Annual Symposium of the Hellenic Nuclear Physics Society, Aristotle University of Thessaloniki, Thessaloniki, Greece, 2019

NTONTIN KONSTANTINOS

Practical Design for Highly Spectral Efficient MIMO Transceivers

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Institute of Informatics & Telecommunications

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INTRACOM TELECOM

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The project focuses on transceiver design for 5G systems and has the following two main aims:
- To design a low-complexity receiver based on frequency-domain equalization that is able to operate satisfactorily under common hardware impairments, such as carrier phase offset, phase noise, carrier frequency unsynchronization, and symbol-timing unsynchronization. Both single stream and multi-stream transmission, through the use of multiple antennas in the latter, are of interest [M1-M24].
- To provide the algorithmic design of a beamsteering transmission system that is going to be based on the hybrid precoding principle that is more affordable than the fully digital design [M25-M36].

Based on the above objectives, the tasks related to the first two years of the project have been largely achieved. In particular, during the 1st year of the project the Industrial Fellow focused on single-stream transmission and realized the design of a receiver based on frequency-domain equalization that operates under the aforementioned hardware impairments. During the 2nd year of the project, the Fellow has focused on the study of multistream transmission and the design of the corresponding receiver that is based on frequency-domain equalization. This study is ongoing and is expected to be completed by M24.

PAPAVASILEIOU KONSTANTINOS

Mesoscale Modelling of Fischer Tropsch Product Mixtures Confined in Graphene Nanopores.

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The Gas-To-Liquids (GTL) process is an established, robust and economically viable technology in harnessing gas resources, such as synthetic gas, for the efficient production of cleaner and high-quality transportation fuels by the petrochemical industry. The Fischer-Tropsch (FT) reaction is fundamental to the fuel production process and its performance is controlled by several factors, such as operating conditions, the choice of the metal catalyst and its support material. These factors affect operational costs and their underlying mechanisms are yet unknown. This project aims at the utilization of mesoscale molecular simulation methodologies on the production of fundamental knowledge in conjunction to the company's goals, in order to address a number of fundamental questions raised by the company's GTL industrial partners. This is the first time that such an attempt is made in the context of FT and the first period was dedicated to the investigation of MARTINI, a coarse-grained model widely used in biomolecular simulations, for its appropriateness in the description of wax – water mixtures at elevated temperatures and pressures. Our examination affirmed its applicability and allowed the study of pure n-alkanes and their mixtures properties such as liquid density, viscosity and surface tension that led to a scientific article. The achievements of the project's first year also include the publication of a book chapter. Currently, wax – water mixtures with or without oxygenates are examined under confinement in graphene and graphene oxide mesopores with mesoscale and atomistic simulations, the results of which shall comprise a second scientific publication.

Conferences
- 30th European Symposium on Applied Thermodynamics (ESAT), Prague, Czech Republic, 2018

Publications
- Multi-scale models for the prediction of microscopic structure and physical properties of chemical systems related to natural gas technology (Natural gas processing from midstream to downstream)",) Wiley, 2018, ISBN: 9781119270256.
- K. D. Papavasileiou, L. D. Peristeras, A. Bick, I. G. Economou, "Molecular dynamics of pure n-alkanes and their mixtures at elevated temperatures using atomistic and coarse-grained force fields", J. Phys. Chem. B, 2019, 123, 6229–6243.

PITTARAS NIKIFOROS

Beyond Deep Learning

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Up to this point, the PhD candidate has performed a thorough study of the theoretical basis surrounding data representations and machine learning models. Specifically, literature on local and distributed representations, shallow and deep learning models, representation learning and hand-crafted approaches has been covered, grounded by an examination of fundamentals of computational learning.

Following this theoretical preparation, research work began, focusing on popular representation and learning models for multiple modalities as well as multimodal approaches. At this point, an initial focus has been set on the text modality, with an additional emphasis on approaches that introduce semantic information in the learning pipeline. Bag-based methods, post-processing representation learning techniques as well as deep neural language models that generate word, document and sense embeddings in an end-to-end fashion were examined. Semantic augmentation techniques covered include learning objective modifications, feature combination strategies, embedding fine-tuning as well as sense-aware representation extraction. This body of research is being compiled and catalogued into a survey study, focused on semantically-enriched text representation methods for classification, to be added to the considerable number of scientific publications achieved as a result of the project progress thus far. Additionally, the codebase used in experimental evaluations performed as a part of the above contributions is bundled in a software package, a tool under continuous development and improvement that enables fast and out-of-the-box large-scale experimentation on popular text datasets.

SEIMENI MARIA

Study of the Human Exposure to Electromagnetic Fields of Wearable Antennas

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SERENE project analyses the exposure of users to electromagnetic radiation from the antennas of wireless wearable devices either embedded in garments, or implantable. The workload of SERENE is organized in five work packages. As of today;-WP1 (completed) regards the investigation of:- (i) literature wearable antennas technologies, exposure to EM radiation of their users and methods to reduce it; (ii) and the related wireless systems of the "HYGEIA" Hospital. WP2 (completed) regards the design and EM simulation of two types of microstrip patch antennas; one selected to serve as reference antenna. Various types and geometries of human phantoms were investigated, simulated and used to study the interaction of wearable antenna with the user's body. To reduce EM energy absorbed by the human body, modifications in antenna design and components selections have been realized in WP3 and will be concluded next year. Reference antenna designs are to be prototyped (due conclusion) and characterized, while the phantom was designed and is ready for fabrication in WP4. The representative of the relevant departments of "HYGEIA" shall gain awareness of project's results via a dedicated presentation and discussion. WP4 will be concluded next year. In WP5, a scientific publication was presented at LAPC 2018, oral presentations were given at NCSR"D" and newspaper. Efforts for proposals submission as a response to ESA ITTs (under negotiation), H2020 and ΕΡΕΥΝΩ-ΔΗΜΙΟΥΡΓΩ-ΚΑΙΝΟΤΟΜΩ were made. According to the annual reports, which summarized in a profound manner project's outcomes, Dr. Seimeni has been dedicated to her duties, delivering results in time and in budget and allocated her time judiciously between SingularLogic S.A. and WiCom Lab of IIT of NCSR"D".

Conferences
- ACM Symposium on Document Engineering, 2018.
- CICLING 2019, La Rochelle, France.

Publications
- Exploring different sequence representations and classification methods for the prediction of nucleosome positioning", bioRxiv, 2018.
- Crowdsourcing in single-document summary evaluation: the ARGO way", chapter in "Multilingual Text Analysis: Challenges, Models, And Approaches", 2019.

Conferences
- The Loughborough Antennas & Propagation Conference (LAPC 2018), Loughborough, 2018.

SIDERIS ANARGYROS

Advanced Surveillance Platform in the Cloud and IoT EraS

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The project's main objective consists on developing a cost-effective, intelligent and IoT aware surveillance platform able to detect anomalous incidents in an urban environment; incidents that can be viewed/interpreted as indicators for possible threats to critical facilities, infrastructures and people. In this direction, the technical objectives are to: a) Design and build a novel low-cost embedded framework with local intelligence and real-time alert categorization based on the utilisation of data stemming from various types of IoT sensors (e.g. cameras, CBRN etc.); b) Design and develop a deployment framework that will support the hosting of third-party analytics algorithms (e.g. intrusion detection, bag snatching, etc.); c)Design, implement and deploy a hybrid, Video Surveillance as a Service (VSaaS); d) Develop a visual analytics framework for strengthening decision making mechanisms; and e) Validate and evaluate the proposed platform/solution exploiting both a lab testbed and a pilot deployed inside the campus of NCSR Demokritos.

Currently, a prototype of a low-cost embedded system where USB and IP cameras can forward their data streams for being analysed. Further to that an analytics deployment framework based on the Docker framework has been implemented. As far as it concerns the cloud based VSaaS, a prototype of the back-end system has been implemented. The front-end is still on development. For the visual analytics the skeleton of the system has been designed and a proof of concept prototype has been implemented. Finally, a lab testbed located at FINT's premises has been implemented for testing and validating the so far implemented prototype systems.

SMYRNAKIS ATHANASIOS

Design and Development of a Hyperthermal Hydrogen Atom Gun for Top Down Proteomics

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Mass Spectrometry has evolved into an indispensable tool in the field of proteomics and applied extensively for the comprehensive characterization of biological samples. The objective of the proposed project is to develop new techniques for the coordinated dissociation of gas phase ions, extending the complete characterization of proteins currently limited to 25-30kDa. Of specific interest is the development of radical reactions in the gas phase based on hydrogen atom bombardment. The project is concerned with the development of a hydrogen atom gun based on a low-pressure plasma source capable of generating a highly density flux of activated hydrogen atoms directed into the storage region of a novel RF linear ion trap, termed the OmnitrapTM platform. Extensive experimental tests for evaluating the performance of the new version of the omnitrap platform developed for the purposes of this project have been performed. New routines are developed for integrating the hyperthermal gun, particularly in combination with electron ionization and electron capture dissociation. A first design of the plasma source has been completed and a prototype test rig has been constructed and is currently under further development. Plasma diagnostics tools are applied for the characterization of both continuous and pulsed operation of the hydrogen plasma source, including a quadrupole mass filter to measure product species generated in the plasma and stopping potential experiments to characterize the kinetic energy spread of the ions. The hyperthermal hydrogen gun is expected to further extend the ability of the omnitrap platform to perform unique tandem MSn experiments.

Other Distinctions

- Grant for the project Innovative technologies and IoT tools for safeguarding cultural heritage monuments against climate change impacts | Smart-HeriTag, Agreement No T6ΥΒΠ-00259.

Conferences

- Conference of the German Society for Mass Spectrometry (DGMS), Rostock, Germany, 2019

STAMATAKIS EMMANUEL

Smart Hybrid Energy Storage and Management (SHESAM)

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Company Mentor:
Kostas Tsiakataras (DBC)
Nikos Giannoulakis (ELFON)
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A Communication Plan to define the means and methodologies of communication among partners (NCSRD/DBC/ELFON) has been established during the project. A well-balanced allocation of the Industrial Adjunct Researcher time has been followed according to the initial proposal phase.

Additionally, the Task 2.1 (Identification of Building Categories) has been completed. In general, four categories of buildings (industrial, residential, special, tourist) have been identified. The most common energy requirements are heating, cooling, ventilation and lighting. The Task focused also on technology introduction in various sectors including a stand-alone smart hybrid RES/hydrogen power system for transport applications (PV/hydrogen filling station). Hydrogen fueling stations (HRS) are one of the most important parts of the distribution infrastructure required to support the operation of hydrogen vehicles. Thus, Task 2.2 (System Modelling & Simulation) & Task 2.3 (Energy Performance Assessment) are being focused on stand-alone hybrid RES/HRS systems. That was a common decision between the adjunct researcher, the NCSRD group and the participating companies (DBC, ELFON) as it reflects current international trends and expressed interest by many stakeholders.

That is also the case for the rest WPs and their associated Tasks (i.e. WP3 – System Specification & design, WP4 – Technical, Environmental & Economic Assessment & WP5 – Strategic Market Analysis) where the work is currently focused on smart hybrid RES/HRS units.

Conferences
- Second International Computational Science and Engineering Conference, Doha, 2017
- 5th Hellenic Forum, NCSR Demokritos, Athens, Greece, 2017

Publications
- Modeling and simulation supporting the application of fuel cell & hydrogen technologies", Journal of Computational Science, Volume 27, p.10-20 (2018)

Other Distinctions
- H2TRANS; Research project funded by the National Partnership Agreement 2014-2020

STRAMARKOU MARINA

Smart Packaging Using Electronic Sensors on Flexible Substrates for the Activation of Food Bioactive Compound Encapsulated with Innovative Methods

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The project is advancing according to the technical program. Research activities has been performed for the isolation of biocompounds, the development of biodegradable nanofibers as well as the design and development of chemical sensors for the food packaging.
- The optimization of the isolation of the bioactive compounds (WP1) from the industrial fruit waste, has been completed. Ultrasound and microwave assisted extractions were applied under different extraction conditions. Green solvents, as well as, deep eutectic solvents were used during the extractions. The total phenolic content and the antioxidant activity of the extracts were determined. The best performed extracts were used in WP2.
- The development of biodegradable nano-fibers (WP2) enhanced with the bioactive compounds from the industrial waste through electrohydrodynamic process, is at the final stage. Three types of matrices are used for the encapsulation of the extracted phenolic compounds: zein, β-cyclodextrin and chitosan. The electrohydrodynamic process was applied in the Tetrapak packaging of Aspis juices under different conditions, such as the voltage, the flow rate of the extract and the matrix and the tip to target distance.
- The development of the chemical sensors (WP3), is in progress. A thorough study about the indicators of juice spoilage that can be detected by the chemical sensors, as well as, of the proper materials for the development of the sensors, was performed. It is concluded that graphene oxide and zinc oxide sensors, which detect the modifications in CO_2 concentration and pH, are critical indicators of quality, freshness and shelf life of juices.
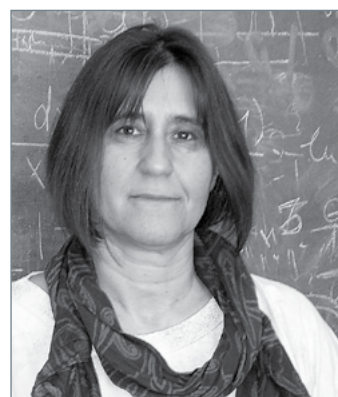
Conferences
- 12th National Scientific Conference of Chemical Engineering, Athens, Greece, 2019
- Food Chem Day, Athens, Greece, 2019

Other Distinctions
- Thomaides award for the presentation "Optimization of the recovery of bioactive compounds from industrial fruit waste" in international scientific conference

TODOROVA NADIA

Novel 2D Nanocrystals for Smart Coatings Applications 2D NanoSmart

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2D metal carbide nanocrystals were successfully synthesized and characterized with respect to their crystallinity, morphology, chemical composition, electronic structure, etc. Titanium carbides with typical 2D morphology were obtained using industrially applicable chemical route that is one of the project's objectives. Composites with other 2D materials such as CNTs, TiO_2 nanosheets etc were developed as planned. The EM shielding and photocatalytic properties of pure metal carbide nanocrystals and their composites were investigated.

The measured up to now EM shielding efficiency and de-NOx activity are promising. The stability of the materials' dispersions in water and organic media was also investigated as they will be further incorporated in industrial formulations for the targeted applications. The first milestone that is stable dispersion with specific concentration was reached. In fact, the stability in organic solvent exceeded 3 months period. Also, it was found that spontaneous oxidation occurs in water and presence of oxygen that is unfavorable for the EM shielding, but beneficial for the photocatalytic activity as the metallic character of the MXenes was shifted to semiconducting (Eg 3.2 eV). As a next step, efficient protection against oxidation will be pursued to preserve the EM shielding properties. The composites will be further optimized in order to be incorporated in industrial formulations for EM shielding and photocatalytic coatings. All deliverables were produced as planned. Selected results were published in the form of paper and oral presentation. Six research projects were submitted and two were selected for funding.
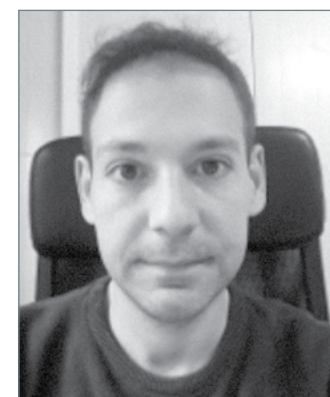
TOLIAS ILIAS

Turbulent Combustion Modelling for Explosion Safety Assessment in Real Scale Industrial Geometries

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Safety assessment of potential explosion accidents is conducted in industrial areas where flammable gases are processed in order to predict the resulting explosion overpressures. This assessment is usually carried out using simple integral codes.

The purpose of the project is to use the more advanced and accurate Computational Fluid Dynamics (CFD) method in order to improve the predictive capabilities in explosion scenarios in complex industrial areas.

A novel combustion model developed in Demokritos is further improved and validated. The comparison with the experiments conducted so far has revealed very accurate predictive capabilities. Real case scenarios in the area of Hellenic Petroleum refinery was selected to be simulated. For the accurate representation of the geometry, 3D laser scanning is a complex area of the refinery was conducted. Geometry details are crucial due to the turbulence that is generated resulting in flame acceleration and pressure increase.

The accurate representation of the geometry in the major asset of the CFD method compared to the simple integral codes that are currently used.

Conferences
- 15th Symposium on Catalysis, Ioannina, Greece, 2019

Other Distinctions
- National Grant by GSRT for the project 2D g-C3N4/TiO2 heterostructures for photocatalytic oxidation of air pollutants".
- 2D Light weight Materials and Coatings for Electromagnetic Interference Shielding Applications –2D EMI Shield" " joint project between NSCR-D and NanoPhos S.A. Selected for funding by ESA.

Publications
- Analysis of a medium-scale hydrogen experiment, International Journal of Hydrogen Energy, 43 (52), 23568-23584

Other Distinctions
- Development of advanced computational models of high accuracy for consequence analysis of flammable gases dispersion and explosion, "Researchers support emphasizing in young researchers grant – Second call", Hellenic republic, Ministry of Economy and Development, 2019.

TROHATOU OURANIA

Podocyte and β Cell Survival Diabetes Mellitus: The Role of Liraglutide

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Diabetic nephropathy (DN) is a major chronic complication in diabetic subjects that develops in 20–40% of patients with Type1 or Type2 Diabetes Mellitus and represents the leading cause of end-stage renal disease. Several observations specify that renal podocyte depletion is an early pathological feature in patients with diabetes and animal models of diabetes could be considered as a hallmark of human and experimental DN. The number of DN patients progressing to end-stage renal disease and requiring renal replacement therapy has continued to increase. The primary objective of the proposed program is to study the role of liraglutide, a long acting fatty acid-derivative of GLP-1, in isolated rat glomeruli cultured in the presence of normal (5mM) and diabetic (25mM) glucose levels. We observed no alterations in podocyte markers expression levels and the PI3K-Akt signaling pathway, suggesting that liraglutide treatment in isolated rat glomeruli may not protect glomerular podocytes from glucose-induced apoptosis. The proposal focuses also on investigating the role of secreted condition media from human Amniotic Fluid Mesenchymal Stem Cells (CM-AF-MSC) in isolated rat glomeruli. Expression levels of nephrin and podocalyxin were rescued by CM-AF-MSC treatment and also the high-glucose-mediated apoptosis presented in isolated glomeruli was significantly decreased. Moreover, a comparative proteomic analysis (LC-MS/MS) was performed before and after CM-AF-MSC treatment. Proteins, such as transgelin, ankyrin-3, endophilin and TBRG4 that have a significant role in cell regulatory mechanisms, were identified. Further study is needed in order to extrapolate the molecular mechanisms involved in preventing podocyte and β-cell apoptosis.

TSOUFIS THODORIS

Innovative Nano-enabled Technical Fabrics by incorporation of advanced multi-functional fillers

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The overall aim of NanoFabulous fellowship is focused at the development of innovative nano-enabled technical textiles based on polypropylene (PP) and polyethylene (PE). The first phase of the project's methodology involved the development and suitable chemical functionalization of selected nano-structured fillers (namely Graphene and Halloysite clay nanotubes). This aspect is a critical milestone for the successful development of the final end-products, since it would ensure the homogeneous dispersion of the additives within the selected polyolefin carriers, and allow the full exploitation of their unique properties originating from their nano-structure. At the same time, it would be avoided the formation of aggregates and/or agglomerates which are well-known to downgrade the performance and the final properties of the resulting nano-composites. Up to day, within this concept and in accordance with the fellowship's work-plan, there have been successfully developed suitable derivatives of Halloysite clay nanotubes and Graphene. The development and evaluation of PP- and PE-based nanocomposites at lab-scale using those aforementioned nano-structured fillers is currently in progress and is expected to be concluded as scheduled. It is worth highlighting that given the industrial aspect of the project, special providence was taken in order all evaluated synthetic strategies and methodologies to be sustainable and fully compatible for large scale application. In this way, all findings and outcomes which will arise from evaluation at lower technology levels can be implemented at the upcoming, final phase of the project which involves the pilot scale evaluation.

Conferences
- 20th Hellenic Conference of Nephrology, May 2018, Athens, Greece
- 31st European Renal Cell Study Group meeting, March 2019, Korinthia, Greece

TSOUGENI KATERINA

Rapid and Accurate Detection of Bacteria in Water Using Microfluidics Technology

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Plasma Enabled Nanofabrication and Applications
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Food and water-borne infections are commonly caused by bacteria. Indeed, more than 90% of the cases of food poisoning are caused by bacteria. These bacteria are commonly found in many raw foods and if present even in small numbers they may cause illness. Very recently Legionella has been identified by the World Health Organization as the highest health burden of all waterborne pathogens in the European Union and many outbreaks are reported around the globe every year. The long delay between sampling and answer, and the resulting low frequency sampling, does not allow for early action to prevent legionella outbreaks, in facilities including recreation centers, hospitals, hotels, resorts and other places of public interest. The importance of developing more efficient water diagnostics for pathogens and faster analyses methods is recognized worldwide, and this is the opportunity this project aspires to fill in towards the realization of a lab-on-a-chip for L. pneumophila detection.

Target of the work during the first 9 months of the project:
1. Lab on a chip fabrication
2. Development of simpler and faster protocol for L. pneumophila detection on chip by a simple color change
3. Preparation of a new patent application

TSOUNIDI DIMITRA

Fast & accurate diaGnosis of sepsis At the point-of-care with Label-free bIoseNsOrS (GALINOS)

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Sepsis is one of the leading causes of death worldwide and its early diagnosis is very important for effective treatment and increase of survival chances. The GALINOS project aims at the development of a small size instrument based on a White Light Reflectance Spectroscopy (WLRS) biosensor for the rapid and accurate determination of three biomarkers related to sepsis diagnosis, C-reactive protein (CRP), procalcitonin (PCT), and inteleukin-6 (IL-6). At first, non-competitive enzyme immunoassays for the three analytes have been developed in order to select for each analyte the appropriate antibody pairs and assay conditions.
The assays developed were sensitive with detection limits of 0.01, 0.1, and 0.0025 ng/mL for CRP, PCT, and IL-6, respectively, and reliable (intra- and inter-assay coefficients of variation < 6%). After that, single analyte assays have been developed to the WLRS platform. All assay parameters have been optimized including, the concentration of capture and detection antibody, the composition of the assay solutions, the duration of each of the assay step and the matrix for calibrators' preparation. The assay developed have detection limits of 0.2, 1.0, 0.2 ng/mL CRP, PCT, and IL-6, respectively. Currently, the assays are evaluated using human serum samples samples provided by a collaborating diagnostic laboratory in order to compare the results with those determined for the same samples by standard methods. In addition, several approaches to increase the assays sensitivity are investigated. As soon as this is completed, the simultaneous determination of the three analytes using appropriately prepared sensors will be investigated.

Conferences
- MNE CPH 2018, Copenhagen, Denmark, 2018
- Micro Nano Bio Systems (MNBS), Thessaloniki, Greece, 2018

Publications
- A modular integrated lab-on-a-chip platform for fast and highly efficient sample preparation for foodborne pathogen screening, 2019, Sensors and Actuators, B: Chemical, pp. 171-179

Conferences
- EUROPT(R)ODE XIV conference, Naples, Italy, 2018
- Athens Conference on Advances in Chemistry, Athens, Greece, 2018

Publications
- Rapid and sensitive label-free determination of aflatoxin M1 levels in milk through a White Light Reflectance Spectroscopy immunosensor, Sensors & Actuators: B. Chemical 282, 2019

TSOUTI VASILIKI

Microsystems for obstructive sleep apnea treatment (MiSleep)

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MiSleep is an interdisciplinary project aiming at the development of a non-invasive system for the effective treatment of Obstructive Sleep Apnea (OSA) syndrome through transcutaneous electrical stimulation (ES) of the genioglossus muscle. During the first two years of the project we emphasized on the market evaluation and the exploitation plan, the integration possibilities of the system as well as the design and the specifications of its main parts, namely the sensing, triggering and signal processing part.
In particular, we have developed the first generation of flexible strain sensors aiming to monitor breathing and apnea/hypopnea events during sleep. The sensors comprise graphene nano-platelets (GNPs) and flexible substrates such as Polydimethylsiloxane (PDMS).
We also fabricated the ES part of the system, which is based on a control unit circuit and a commercially available transcutaneous electrical nerve stimulation (TENS) device for ensuring safety issues. After having studied the electrode characteristics and triggering patterns, we are currently scheduling first clinical tests on patients for the evaluation of the stimulation conditions.
Regarding the signal processing for the automation of the OSA treatment system, most of the machine learning algorithms that are used for the monitoring of sleep apnea events typically require long time periods in order to be efficient. We develop our algorithms using signals from open and anonymised databases of polysomnography (PSG) studies and home sleep tests. Special effort is given on effective real time processing and consideration of the sensors that may effectively contribute to a comfort and highly efficient system.

VOURDAS NIKOLAOS

Smart surface functionalization for high added value ceramic powders and structures (ADVANCER)

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In the following Table the list of Objective of advanCER is provided.
01. Surface functionalization of ceramics with F-containing monolayers (Technical objective)
02. Surfaces functionalization of ceramics with ultra-thin MeOx and MeSx films (Technical objective)
03. Open new markets and revenue opportunities for MIRTEC S.A. (Non-technical objective)
04. Strengthen collaborative activities of NSCR "D" with industry (Non-technical objective)
05. Pursue funding from research projects for both NCSR "D" and MIRTEC S.A. (Non-technical objective)

The Project is on-track and all activities towards reaching the objectives are running smoothly and within the timetable. The preparation and characterization of ceramic powders and structures with F-containing monolayers have been achieved successfully and some applications have been already demonstrated. The surface functionalization of ceramic powders and structures with MeOx and MeSx has been done and characterized. Key-applications have been identified with MIRTEC and testing against specific goals has been demonstrated.

Conferences
- 15th International Conference on Nanosciences & Nanotechnologies, Thessaloniki, Greece, 2018
- 16th International Conference on Nanosciences & Nanotechnologies, Thessaloniki, Greece, 2019

Conferences
- 71st Annual Meeting of the APS Division of Fluid Dynamics, Atlanta, Georgia, USA, 2018

Publications
- A new microfluidic pressure-controlled Field Effect Transistor (pFET) in digital fluidic switch operation mode, Microelectronic Engineering 190, 2018
- Computational investigation of actuation mechanisms of droplets on porous air-permeable substrates, Soft matter 14 (29), 2018

VOURNA POLYXENI

Robust Antifouling Composite Technology (RACkET)

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The main goal of RACkET project is to develop a novel conductive composite with enhanced photocatalytic activity for the formulation of highly effective and enduring ecofriendly coatings for ships' hulls.

During the second year, the primary focus of the research conducted was to efficiently combine and finely tune conductive and photocatalytic properties of the composite proposed in RACkET at both laboratory scale and in-field. Laboratory results would serve as a pilot formulation towards the development of the antifouling coating. After completing the preliminary field analysis, the Industrial PostDoc candidate, together with the Mentor of NCSR "Demokritos" and the Mentor of BFP Advanced Technologies, established the composite's structural design. The current experimental scheme has been based on the conjunction of conductive nanorods decorated by nano-photocatalysts and carbon nanofibers (CNTs) filled with magnetic nanoparticles.

As a result of the work conducted so far, the project's consortium has highlighted the importance of thorough dispersion of magnetite-carbon nanotubes (Fe_3O_4-CNTs) and of homogeneous distribution of polyaniline-titanium dioxide (PANI/TiO_2) nanorods within the soluble matrix in order to enhance conductivity and to provide an additional functionality for the final coating. During the second experimental stage, the anti-fouling coating was non-toxic and that the total amount of primary colonizers and second colonizers, has been reduced in both static and docking conditions at a rate of about 71% and 62%, respectively. The in vitro screening results showed relatively low fouling phenomena in static conditions, and both antifouling and foul-release properties during ship's movement.

ZACHAKI SOPHIA

Identification of Genetic Biomarkers Associated with Endometriosis Related Infertility and Malignant Transformation

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The main aim of the research is the identification of cytogenetic biomarkers for the early identification of women with endometriosis who are in danger for malignant transformation, as well as specific microRNA biomarkers for non-invasive diagnosis of endometriosis.

The laboratory of Health Physics, Radiobiology and Cytogenetics of NCSR "Demokritos"has established an excellent collaboration with the Genesis Genoma Lab and the Athens Genesis Clinic in the frame of endometriosis research. Based on the extended research experience of the scientific personnel implicated in the proposed study in the fields of Medical Genetics and human reproduction, the standardization of accurate, simple and inexpensive protocols appropriate for endometrial tissue culture, karyotypic analysis and fluorescent in situ hybridization (FISH) analysis was achieved. Until now, the procedures for inform patients and get their biological material have been established. In this frame, 22 women have been already enrolled in the study after written inform consent for their voluntary participation in the research and preservation of their biological material in a Biobank at NCSR "Demokritos". Successful karyotypic analysis of ectopic endometriotic tissue that was surgically removed was further analyzed using Cytogenetic techniques (karyotype and FISH). From the current data seems that genetic changes such as polyploidy and IGH gene rearrangements may play a role in the development and/or progression of endometriosis.

The immediate objective of the project is also the evaluation of possible miRNA biomarkers for non-invasive diagnosis of endometriosis. This will help the patients' management by reducing the number of the redundant invasive procedures.

Conferences

- 11th European Cytogenetics Conferences, European Cytogenetisists Association, Florence, Italy, 2017
- 29th Hellenic Society for Social Pediatrics and Health Promotion Conference, Kavala, 2017
- 19th Hellenic Congress of Perinatal Medicine, Hellenic Society of Perinatal Medicine, Athens, 2017
- 14th National Congress of Obstetrics and Gynecology, Athens, 2018
- 28th Hellenic Hematology Congress, Hellenic Haematological Society, Athens, 2017
- 3rd Panhellenic Conference of the Hellenic Society of Medical Genetics (SIGE), 2018
- 6th Panhellenic Conference of Children and Adolescent Gynecology, Hellenic Society for Child and Young Gynecology, Thessaloniki, 2019

ZISIS GRIGORIS

Accurate Thickness and Reflective Index Mapping of 2D Materials by Reflectance Spectroscopy and Imaging Technique (SLICE)

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Theoretical modeling of waves in the Micro and Nanoscale Group
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The "SLICE" project is a joint Industrial Fellowships Program funded by Stavros Niarchos Foundation, between ThetaMetrisis S.A. company and NCSR "Demokritos". The technical objectives of the project are:
1. To provide a simple yet powerful surface analytical technique based on reflectance spectroscopy in a broad wavelength range (UV-Vis-NIR) and a variation of optical reflection microscopy. This would also advance the existing know-how of the industrial partner in thin-film characterization.
2. The development and validation of measuring and modelling tools to correlate the structural and optical characteristics of 2D materials in industrially relevant environments.
Within the first two years of the SLICE project, the research efforts directed towards the successful design, development and evaluation of the novel optical technique, and the production and launching of a new product in the semiconductor metrology market. During the first months, the final optical set-up assembly developed after testing numerous different configurations. Subsequently, a theoretical approach to solve the observed distorted reflectance spectra, was explored and implemented after experimentally confirmed. At the second year, the accuracy and precision of the system were evaluated on measurements upon several samples (both on 2D and thin/thick films). Special cases tested as well, like thickness measurements on Mo_2C crystals of micrometer-sized diameter, biomolecular layer thickness determination for the detection of anti-bodies, reflectance and PL spectra of aluminum nanosquare metastructures, demonstrating successfully the powerful capabilities of the system. Consequently, a prototype developed and after extended tests, on March 2019, a new product (FR-μProbe) was launched in the market.

AMPOUMOGLI ASEM

Fabrication and Characterization of 3D Printed Thermoelectric and Magnetic Components for Smart Applications

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The project aimed to investigate the production of specialty 3D printing filaments aimed at magnetic, dielectric and thermoelectric applications, taking advantage of the freedom afforded by 3D printing in generating complex geometries. Another one of the essential aims was to produce filaments that could be used with a typical 3D-printer thereby reducing the prototyping costs for developers in these specific fields.
We identified the raw materials needed for state-of-the-art applications and the relevant methodologies for producing composite 3D-printable filaments which would retain the desired technical properties of the raw materials, e.g. magnetic and dielectric properties.
Over the course of the one year of research, we developed innovative methods for the characterization and the production of the composite filaments, taking advantage of the research facilities and expertise available in NCSR Demokritos.
After iterative testing appropriate methodologies were developed, leading to the successful production of printable composite filaments in the case of dielectric and magnetic filaments.

Conferences

- 45th International Conference on Micro & Nano Engineering (MNE2019), Rodos, Greece, 2019

Publications

- Rapid and sensitive label-free determination of aflatoxin M1 levels in milk through a White Light Reflectance Spectroscopy immunosensor, Sensors Actuators B Chem. 282, 104 (2019).

BOUKIS FILIPPOS

Compact membrane reactor combined with novel membrane in intensification systems to produce low-cost hydrogen from biogas

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Detailed studying has been carried out towards choosing the appropriate materials to be utilized in the lab scale reactor, which could, also, prove ideal for large scale applications. After evaluation of the state of the art, it was concluded that the most common element for both hydrogen separation and methane reforming catalysis, used in membrane systems, is palladium most of the times alloyed with other metals. Its high price, thought, leads to the search of other metals, exhibiting familiar catalytic behavior, like nickel, as feasible alternatives. Based on that, we focused, not only on the comparison between nickel and palladium catalytic membranes for methane reforming applications, but also on the selection of the more suitable coating method. The scientific research was focused in the coating of ceramic membranes via a spark discharge metal nanoparticle generator device, which creates aerosol nanoparticles of a metal of our choice.

A laboratory setup was designed and implemented, combining the spark discharge metal nanoparticle generator device, a membrane cell, a vacuum pump, two mass flow controllers. The initial permeability values of the tubular alumina membrane were determined, before coating it with cooper nanoparticles in the spark discharge generator setup. Cooper was chosen for preliminary deposition experiments, because of its extended availability and low price, which will be replaced with Ni, Pd, or Pt, later. Until now, repeated cycles of metal nanoparticles deposition have taken place, followed by membrane permeability measurements in-between, for optimization of the catalyst quantity applied

Conferences
- 12th Panhellenic Conference Chemical Engineering, Athens, 2019

DOUSKOS VALSAMIS

Advanced Learning and Perception for Infrastructure Security (ALPIS)

Environmental Research
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**Institute of Nuclear
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computer vision engineering

Company Mentor:
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The ALPIS project aims at developing novel methods in industrial-grade algorithms for efficiently fusing and analyzing multimodal visual data for monitoring critical infrastructures and for providing situation awareness in disaster management scenarios. On one hand, advancements of UAV/ ROV technology and optical sensors have increased their reliability and operativity for the acquisition of the data required for monitoring applications.

On the other hand, the development of advanced embedded computing solutions allows the use of cutting-edge recognition and reconstruction algorithms. The visual data will be derived from RGB, multispectral, thermal and short-wave infrared cameras, which will be integrated on UAVs (fixed-wing, or drones), ground vehicles and ROVs for maritime installations. The main contributions of the proposed project are:
- the in-time acquisition of short-range data for monitoring infrastructure elements and for now-casting using unmanned aerial vehicles (UAVs);
- the development of suitable algorithms for on-board processing for understanding and reacting in real-time to the environment using high-end embedded computing solutions;
- the introduction of novel approaches based on cutting-edge deep learning and 3D reconstruction techniques for off-line processing of the acquired data for now-casting and situation awareness regarding critical infrastructures.

ENOTIADIS APOSTOLOS

Advanced Multifunctional Coatings for Outdoor Applications

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The ultimate goal of this project is the development of new, efficient multifunctional coatings systems for large areas coverage, possessing a rare combination of mechanical durability, weather stability and hydrophobic/ self-cleaning/anti-icing properties.

Within the project the modification will be pursued through the incorporation of specially developed nanoadditives, mainly based on silica. Special attention will be given to the structural characteristics of silica nanoparticles and their surface functionalization, attaching appropriate functional groups that will impart poor water wetting to the final coating.

The advantage of using silica-based nanofillers is that they can easily lead to innovative materials with low cost, well-known surface chemistry, no toxicity, well-defined structure, mechanical robustness and UV stability.

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Dosimetry Using MOSFET

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The overall objective of the project is to develop a new innovated system for medical dosimetry, using field effect transistors p-MOSFETs. The system will be used as a real time or passive dosemeter with special specifications in order to collect doses from electrons, photons and neutrons.

The benefit emerging from the implementation of the project is to fabricate a complete measurement system for medical dosimetry based on p-MOSFET with particular characteristics, such as low power consumption, small size and weight in order to be positioned everywhere even inside cavities. These characteristics are very important in medical applications especially in braxy- therapy.

The device will be fabricated by an innovated technology in order to be of high sensitivity to different types of radiations as it is the mixed field during the medical applications and capable to discriminate the different types of radiation

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GEORGIOPOULOS PANAGIOTIS

BioPolyCeram": "Development of Novel Bio-degradable and Recyclable Ceramic-filled Polymer Hybrids

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The first step of the project was the preparation of biodegradable and bio-based composite materials, based on Polylactic Acid (PLA), through melt-blending and compression molding. After optimization of the processing route, in terms of the parameters of thermal processing, composite panels were successfully prepared. The reinforcements of PLA were (a) ceramic fire-clay, prepared into the lab and (b) basalt fibers (commercial product).

The next step was the chemical treatment of the reinforcements, in order to form covalent bonds at their surface and avoid hydrogen bonding with the polymer. Thus, matrix-fillers strong adhesion was acquired by treating the fillers with silane coupling agents. The procedure was firstly optimized in terms of the silane amount, treatment and drying time. Thermo-mechanical characterization of the composites was the most important tool for the evaluation of the treated composites, as there was significant improvement at the mechanical properties and the heat deflection temperature.

A critical aspect of bio-based/biodegradable materials is their durability. Due to their susceptibility to hydrolysis, their properties deteriorate even under moderate environmental conditions. After thorough study of the aging behavior of the prepared composites, polymeric carbodiimide additives (CDI) were successfully used as an additional agent, in order to delay the hydrolysis reaction. Indeed, by using a specific CDI grade, aging behavior was adequately tailored, paving the way for the gradual establishment of bio-composites to applications requiring durability.

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KAPLANIS MICHAIL

Rhenium and Technetium Complexes as potential antitumor agents

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In the first year of the Industrial PostDoc all the experiments were conducted with success and according to the schedule. The results were very encouraging and promising. Many of these results were published both in peer-reviewed paper and international conference as oral or poster presentations.

The last months, I am working in the company Biokosmos SA, so the fellowship clearly succeeded its aim.

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KONTOPOULOS IOANNIS

Distributed Complex Event Recognition and Forecasting

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Event processing has been established as a generic computational paradigm in a wide range of applications. Events report on state changes of a system and its environment, thereby enabling reactive and proactive computing. At the core of event processing systems is an event recognition mechanism. It is the ability of a system to detect events that are considered relevant for processing and, as such, is the basis of situation awareness.

The goal of this project is the development of generic event recognition technology that may be utilized for maritime surveillance. To deal with the lack of veracity, probabilistic reasoning techniques will be employed. To address data volume, velocity and distribution, novel algorithms for distributed reasoning under uncertainty will be developed. Moreover, to allow for proactivity, event forecasting techniques will be proposed.

The generic event recognition and forecasting technology will be evaluated using real data streams from the maritime domain.

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