Funded by the European Union

FunctiGlass

Project title DC9: 3D printing of biophotonic biomaterials

Recruiting institution: Institute of Low Temperature and Structure Research, Polish Academy of Sciences, Wrocław (Poland)

Background
Over the past four decades, **glass, glass-ceramics and composites** have contributed to the most advanced socio-economic breakthroughs as high-tech materials. To compete with emerging economies such as China and India, the European glass sector must strive for product leadership by investing more in research and innovation to develop new materials and train specialists for a competitive but promising market.

Contributing to this challenge is the main objective of the 'Structured functional glasses for lasing, sensing and health applications' (FunctiGlass) project, dedicated to **advanced high-tech materials for three sectors: light sources, sensors and biological applications**.

FunctiGlass, coordinated by CNRS, is a unique interdisciplinary research and training programme with a **double degree** as part of Horizon Europe's Doctoral Networks (Marie-Skłodowska Curie Actions, project 101169415). It will train 11 doctoral candidates who will take part in a joint research training programme based on **very close cooperation between academia and industry**. It will ensure that the trainees are exposed to 11 academic environments (universities and research institutes) and 9 non-academic environments (industry and SMEs) representing 9 different countries. **Each PhD candidate will be supervised by two academic tutors from different countries (spending her/his time between both units) and one mentor (industrial partner)** to ensure cross-sector knowledge

sharing and the acquisition of transferable skills with a focus on entrepreneurship and innovation. Through the multi-dimensional training of the FunctiGlass programme, the 11 PhD candidates will excel in the future economy by acquiring a multi-dimensional perspective and mindset to become **future leaders in glass science and in particular glass-based nano/micro-structured materials**. Through this programme, they will find their own path of innovation in academia or industry.

The project will create the conditions necessary for the establishment of long-term relationships between the academic and private sectors for the transfer of technologies and skills.

5 institutions will award the double degrees: Université Côte d'Azur (Nice, France), Tampere Universities (Finland), Gottfried Wilhelm Leibniz University Hannover (Germany), University Milano-Bicocca (Italy) and the Institute of Low Temperature and Structure Research, Polish Academy of Sciences (Wroclaw, Poland).

Industrial partners: AOI Tech (France), Corning (France), Fastlite (France), Klearia (France), Else Nuclear (Italy), Nobula3D (Sweden), Nyfors Teknologi (Sweden), Rosendahl Nextrom (Finland), Scout Scientific Outsourcing (Poland).

Other universities involved in the project as partners (not awarding doctoral degrees): University of Cergy-Pontoise (France), University of Gent (Belgium), University of Pardubice (Czech Republic), University of Nazarbayev (Kazakhstan), Umeå University (Sweden).

Description of the PhD project

Bone regeneration is a complex process that requires the precise coordination of cellular, molecular, and structural events to restore tissue integrity and function. Despite significant advances in the field of tissue engineering, bone defects and fractures continue to pose a significant challenge, often resulting in prolonged healing times, discomfort, and increased risk of infection. To address these limitations, researchers have turned to the development of new bioactive scaffolds (3D porous constructs) that combine the benefits of biodegradable materials with other on-demand properties. These innovative scaffolds aim to provide a conducive environment for cells differentiation and growth leading to bone regeneration, while preventing infection and promoting healing process.

Bioactive glasses are known to be osteoconductive or even osteostimulative. Their composition can be tailored to produce scaffolds with well controlled pore size and overall porosity for optimum fluid transfer and cell migration, leading to bone reconstruction in 3D but also promoting angiogenesis. The introduction of antimicrobial properties into bioactive scaffolds can be achieved through various strategies, including the incorporation of antimicrobial agents (e.g. drugs), nanoparticles, or bioactive peptides. The on-demand antimicrobial properties (a drug release in a spatial temporal manner) can be triggered in response to specific stimuli, such as changes in pH, temperature, or light. Hybrid bioactive scaffolds with on-demand antimicrobial properties represents a promising area of research, with potential applications in orthopedic and dental implantology, wound care, and tissue engineering.

The strategy that will be explored in this project, is the combination of bioactive material, light, photonic crystals, and photocleavable drugs. A nitric oxide donor (antibacterial agent) will be loaded/grafted onto the bioactive glass. Photosensitive NO-donors, typically, exhibit NO cleavage in the visible wavelength range, where tissues are not transparent. To overcome this challenge, biophotonic materials (bioactive glass combined with photonic crystals) will be developed. The aim is to irradiate the implant material in the near infrared (NIR), where the tissues are the most transparent, convert the NIR light into visible light, to finally trigger the NO release. So the goal of the research will be to design, fabricate, and test 3D-printed bioactive scaffold containing photonic crystals. The scaffolds will be embedded in gel (gelatin and/or chitosan) containing the photoactive drug. The chemical and physical interaction between all the components will be investigated. The role and importance of each part of the complex system will be carefully studied, that is to say: (i) the energy transfer in luminescent species leading to visible light emission, (ii) the ability to excite in the NIR to trigger the photo-release of nitric oxide, (iii) the ability for drug encapsulation; (iv) the antimicrobial activity caused by nitric oxide and/or drug release, and (iv) the bioactivity of scaffold leading to cell differentiation and growth, and eventual tissue regeneration. An optically active scaffold relevant for bone regeneration with on-demand antimicrobial properties is expected as a result of the project.

Practical information

- Contract will start in October 2025, for 4 years.
- Recruiting institution: Institute of Low Temperature and Structure Research, Polish Academy of Sciences, Wrocław (Poland)
- Doctoral school: Wrocław Doctoral School of Institutes of Polish Academy of Sciences (ILTSR PAS)
- Host laboratory: Division of Optical Spectroscopy, ILTSR PAS
- Supervisor: Ass. Prof. Anna Lukowiak
- Co-host laboratory: Bioceramics, Bioglasses and Biocomposites group, Faculty of Medicine and Health Technology, Tampere University, Tampere (Finland)
- Co-supervisor: Prof. Jonathan Massera
- Industrial mentor: NOBULA3D AB
- Secondments: CY Cergy Paris University, Paris, France; Ghent University, Ghent, Belgium
- The gross monthly salary based on the MSCA rules varies between 1920€ and 4063€, depending on the country of recruitment.
- The student will also receive a mobility allowance and a family allowance (depending on family situation) of up to 600 € and 495€ per month, respectively.

Recruitment criteria

- MSCA Mobility Rule: researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of the recruiting beneficiary (Poland) for more than 12 months in the 36 months immediately before their date of recruitment
- All researchers recruited in a DN must be doctoral candidates (i.e. not already in possession of a doctoral degree at the date of the recruitment)
- Possession of a Master’s degree before the start date of the contract
- Fluent (oral and written) English skills as the project operates in English
- Knowledge of the language of the host countries may be considered a merit
- Team-mindedness

Criteria specific for PhD9

- Knowledge in chemistry, physics, materials science
- Knowledge in inorganic materials processing and characterization
- Knowledge in biology and work experience in microbiological laboratory will be considered a merit
- Work experience in chemical laboratory
- Scientific interests to fit the PhD project (in optics, spectroscopy, and/or biomaterials)
- Master degree in Chemistry, Physics, Materials Science, or related disciplines

Application
Documentation to be sent in by the applicants

- Application form completed
- CV + Letter of motivation
- Contact of two reference persons to be contacted by the selection committee (name, relation to the candidate, e-mail address and phone number)
- Complete list of publications and academic works
- Proof of language proficiencies
- Proof of master diploma or 2024 registration to master degree

How to apply?

- Download application form and fill it indicating all the offers you wish to apply for
- Send your application by email to **recruit@functiglass.eu**. The title of your email MUST be:
  FunctiGlass PhD x, x, x application (x, x, x being the number(s) of the PhD position(s) you want to apply for)
- Be careful to join all documentation required (see list above)

Deadline for application
15th April 2025

Contact
contact@functiglass.eu