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ERC Starting Grants 2016: Examples of projects

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Energy from enzymes

Renewable hydrogen fuel has for many years loomed on the horizon, promising the ultimate clean energy carrier. It would diminish the world's dependence on coal, oil and gas, while tackling the challenge of global warming. But there has always been a problem: how to produce hydrogen that would make both environmental and business sense. Traditional electrochemical production is generally expensive and often relying on scarce noble metals. This was enough to stall the idea of using hydrogen as energy carrier, until scientists identified a class of enzymes, called hydrogenases, which were able to produce hydrogen without the use of precious metals.

Dr Gustav Berggren, from Uppsala University in Sweden, has developed a method by which a hydrogenase can be activated using synthetic mimics of its catalytic cofactor. He is now working to provide new data on the mechanism of activation as well as on the catalysis of this important enzyme in living systems, for example in cyanobacteria, organisms that can live off solar energy.

Project: Chemistry and Biology in Synergy - Studies of hydrogenases using a combination of synthetic chemistry and biological tools (CaBiS)

Researcher: Gustav Berggren

Host institution: Uppsala University, Sweden

ERC funding: 1.5 million euro over 5 years

Building economic theories from a dynamic perspective

Most economic environments are intrinsically dynamic. Transactions and players evolve over time and so can the preferences and choices of a consumer, or the perceived quality and value of a specific product. What are the implications of these changes and fluctuations for economic behaviour? Much remains to be learned about this question.

For Prof. Daniel Garrett, from Toulouse School of Economics (TSE), behaviour can only be fully understood from a dynamic perspective. In his ERC research he focuses precisely on "dynamic mechanisms", i.e. the agreements between sellers and buyers, employers and employees, regulators and firms in the long term. He tackles questions such as how competition affects long-term contracts; how to ensure that an economic transaction can be engaged at the first possible opportunity in time; or which factors can influence the early allocation of capacity, for instance in pre-event ticket sales and travel booking. Prof. Garrett's grant will support work that seeks to explain dynamic behaviour and which could have a significant impact in a wide range of fields, from understanding employment practices to informing competition rules and taxation policies.

Project: Dynamic Mechanisms (DYNMECH)

Researcher: Daniel Garrett

Host institution: Fondation Jean-Jacques Laffont/TSE, France

ERC funding: €1.3 million over 5 years



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Chemical-free water purification with the help of graphene

According to the UN, every day, 2 million tons of human waste is disposed of in watercourses. In developing countries, 70% of industrial waste is dumped untreated where they pollute the usable water supply. Overcoming this challenge requires new technologies that are sustainable, robust and energy-efficient. Dr Jelena Radjenovic from the Catalan Institute for Water Research proposes to develop a pioneering, chemical-free water purification technology with nanoelectrochemical systems based on low-cost reduced graphene oxide.

Current research on the use of graphene-modified electrodes is focused on energy storage and conversion. In these applications, graphene's defects limit its performance. Dr Radjenovic aims to turn this weakness into an advantage to induce electrosorption and electrocatalytic degradation of pollutants. The graphene-coated material will be employed for the first time for the removal of contaminants and pathogens from water.

Project: Three-dimensional nanoelectrochemical systems based on low-cost reduced graphene oxide: the next generation of water treatment systems (ELECTRON4WATER)

Researcher: Jelena Radjenovic

Host institution: Catalan Institute for Water Research, Spain

ERC funding: €1.5 million over 5 years

Citizenships of the world

Migration poses unprecedented dilemmas for countries and challenges the concepts of the nation-state, self-determination, and citizenship. It also lays bare the inadequacy of the current international legal system to govern the new global reality. Professor Liav Orgad, with a project based at the European University Institute, intends to confront the dominant view that citizenship allocation should remain a matter of strictly domestic jurisdiction.

Prof. Orgad makes the case for the establishment of International Citizenship Law (ICIL). This new subfield of international law could set common legal standards for countries to establish naturalization requirements. In doing so, ICIL will follow a *jus nexi* principle of membership: demonstrating a genuine link to the country and fulfilling certain conditions according to a functional points-based system would open an alternative path to citizenship. Prof. Orgad's research will make the very first step in the development of an ICIL regime and advance the idea that ICIL would ensure a better protection of human rights, while better serving the interest of states. This could be especially beneficial in Europe, where the lack of a consistent EU nationality law complicates already existing frictions.

Project: Global Citizenship Law: International Migration and Constitutional Identity (GlobalCitizenshipLaw)

Researcher: Liav Orgad

Host institution: European University Institute, Italy

ERC funding: €2 million over 5 years



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Interactive skin: technology in a tattoo

Wearable technology has become increasingly ubiquitous. However, current mass-produced devices still follow the conventional paradigm of off-body, one-size-fits-all gadgets. Professor Jürgen Steimle, at Saarland University, aims to revolutionise this field by creating body-worn electronics in biocompatible patches made of silicone and ultrathin rub-on tattoos – Interactive Skin. The new devices will resemble human skin and will create an interactive layer seamlessly blending with natural skin. Interactive Skin may find applications in health monitoring, rehabilitation, robotics, and mobile computing. Professor Steimle's ambition is also to provide end-users with easy-to-use software, so that they can freely design, personalise and print their own Interactive Skin.

Project: Digital Fabrication of Personalized On-Body User Interfaces (InteractiveSkin)

Researcher: Jürgen Steimle

Host institution: Saarland University, Germany

ERC funding: €1.5 million over 5 years

Immune cells that deliver anticancer drugs

Cancer kills one woman and two men in the EU every ninety seconds. Despite enormous scientific advances, the patients with solid tumours have poor prognosis mainly due to inefficient drug penetration to tumours with abnormal blood vessels and little oxygen.

Prof. Magdalena Król from the Warsaw University of Life Sciences seeks to open a new research front within the field of drug delivery to hypoxic regions of solid tumours. She has already discovered a new physiological mechanism by which immune cells efficiently uptake box-like natural proteins and once they meet cancer cells, they transfer these protein boxes to them. Immune cells used in this project migrate to the hypoxic regions of solid tumours and their metastases. Prof. Król will load these protein boxes with anticancer agents and administer them to immune cells that deliver drugs to the tumours.

Project: Entrapment of Hypoxic Cancer by Macrophages Loaded with HAP (McHAP)

Researcher: Magdalena Król

Host institution: Warsaw University of Life Sciences, Poland

ERC funding: €1.4 million over 5 years



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Boosting crops' immune system

Fungal diseases and highly virulent plant pathogens endanger global production of food crops, considerably reducing yields. They can be fought with fungicides and pesticides, yet these substances are not always safe for humans and the environment.

Plants, however, have their own ability to detect and disarm rapidly evolving pathogens, including viruses, bacteria, insects and fungi. Their powerful defence mechanisms rely on a particularly rich arsenal of plant immune receptors. Among these, NLR-IDs are proteins which have proliferated for at least 500 million years and serve as "baits" for pathogen molecules. Dr Krasileva, Group Leader at the Earlham Institute and The Sainsbury Laboratory in Norwich, will investigate how these receptors diversify in maize, rice and wheat. Her research into plants' immune system could create new genetic solutions for protecting plant health and future sustainable crop production.

Project: Mechanisms of Immune Receptor Diversification in Cereals (MIREDI)

Researcher: Ksenia Krasileva

Host Institution: Earlham Institute and The Sainsbury Laboratory, UK

ERC funding: €1.5 million over 5 years

Deaf representations: in their own hands

Society is dominated by communicative regimes based on spoken language. Even Deaf Studies, which has now been carried out for decades, is still predominantly led by hearing scholars. With an all-deaf research team, Dr Annelies Kusters, at the University of Leuven, will explore and affirm the visu-gestural and tactile perspective of deaf signers.

Dr Kusters will investigate how, thanks to sign language, deaf people cross international borders and experience transnationalism. She will explore the correlation between the status of being deaf and other statuses, such as ethnicity, nationality, education, religion, and gender. The team will rely on visual methods to carry out the project and will produce ethnographic films intended for broad dissemination. Dr Kusters' research thus aspires to open the way for a paradigm shift in Deaf Studies - a field which has the potential to innovate other disciplines, such as migration, minority, diversity, and disabilities studies, by temporarily "muting" them and leading them towards a more visual approach.

Project: Deaf mobilities across international borders: Visualising intersectionality and translanguaging (MobileDeaf)

Researcher: Annelies Kusters

Host institution: University of Leuven, Belgium

ERC funding: €1.5 million over 5 years

More information

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