



The Foremat project has focused on developing different photovoltaic films.
/ VÍCTOR TRIÁS

Researching in materials to boost **NANOMEDICINE**, energy and electronics

The ICMAB, with over 250 researchers, is the CSIC's number one centre in securing competitive funding from the H2020 programme

By **Victor Lloret Blackburn**

Much has been said about the comparative advantages of public investment in Research and Innovation in the extraordinary setting of a world-wide pandemic. But it is not only in times of urgency and upheaval that we must reflect on the advantages of governmental investing in the advancement of science and technology. The eighth European Union framework programme on R&D, Horizon 2020 (2014-2020), has sown seeds in all the lands it encompasses. In Spain, under the aegis of the CSIC, this programme has been very fruitful. One of the more fertile grounds has proven to be Barcelona, where the ICMAB (Institute of Materials Science of Barcelona) has obtained millions of euros to launch promising projects.

Four of the most successful ones in the last batch of projects, under H2020 program, are a good example of the diversity of research that is being carried out in the ICMAB. This Institute, which was founded over three decades ago in the campus of the Universitat Autònoma de Barcelona, focuses its research on the fields of nanomedicine, energy, and electronics. It employs over 250 researchers, it has managed to be the CSIC's number one centre in securing funding from the H2020, and it has also been selected twice as Centre of Excellence Severo Ochoa by the Spanish Ministry of Science and Innovation.

It is also the foremost CSIC affiliate in number of Principal Investigators (PI) involved in the Horizon 2020 projects and in the amount of funding. In total, 49 PIs are coordinating or participating in H2020 projects, with a budget of 30.1 million euros. As highlighted by **Xavier Obradors**, the director of ICMAB, the key of the success has been the outstanding interdisciplinary environment and the commitment of the personnel to face challenging goals.



M. Rosa Palacín's team explores the use of calcium as an alternative metal-based battery technology

One of the fields that needs levelling is the one covering the medical conditions that are too rare for them to be considered profitable by the private sector. The medicines dealing with these conditions are labelled with the -rather forlorn- definition of *orphan drugs*. One of these ailments is the condition known as Fabry Disease. It is caused by a genetic mutation that renders those suffering it unable to produce an enzyme needed to break down certain lipids and fats. This has effects on the kidney, the heart, and the brain. To ensure that people suffering from Fabry can lead a relatively normal life, what the body doesn't produce must be artificially created by laboratories. This doesn't only mean producing the enzyme, it also includes the creation of the vehicle in which it will travel to the patient's organism. At present, there is a drug in the market for people suffering from Fabry, but the enzyme is degraded by the time it reaches the cells needing it. This is where the project headed by the ICMAB, called Smart4fabry, comes into play. The EU funding for this project has surpassed the five-million-euro mark.

The person in charge of the team working in the Smart4Fabry project, **Nora Ventosa**, explains one of the beauties of Horizon 2020: she has not only coordinated her own team; this has been a joint effort encompassing not only other institutions affiliated to the CSIC, like the Institute for Advanced

Chemistry of Catalonia (with a team led by **Miriam Royo**), but also academic institutions and companies from five different countries. Thanks to their combined efforts, they have managed to create a new, more efficient, capsule for the enzyme, which has so far overcome the first major pre-clinic hurdle before reaching the clinical phase, and has received the Orphan Drug Designation from the European Medicines Agency.

Also within the Horizon 2020 programme, researcher **M. Rosa Palacín** of the Solid State Chemistry group has been working in a field with ramifications in the lives of all of Europe's citizens. In a world that's trying to switch from fossil fuels to electricity, one of the essential elements is the battery, where the power is stored and generated. Most electric devices work on lithium-ion batteries, built with expensive raw materials like nickel and cobalt. What Palacín's team has worked on is in a project called Carbat, exploring the use of calcium as an alternative metal-based battery technology. The fact that calcium is the fifth most common element on Earth would drastically lower the cost of the raw materials for producing such batteries. It would also mean that this cost wouldn't be subject to geopolitical or market upheavals. The results have been promising and Palacín considers them "the foundation from which to expand" towards a new, more sustainable, horizon. This project has seen the Spanish team work in coordination with teams from the Chalmers University of Technology in Gothenburg, the Universidad Complutense in Madrid, and the Fraunhofer Society in Germany.

Teresa Puig, from the Superconducting Materials and Large Scale Nanostructures group, is leading a team working in the energy field, but in this case within the European Research Council, a division of the Horizon 2020 programme. Their project is called Ultrasupertape, and it aims to find ways to diminish the energy wasted when it



Laia Avilés, JAE-Intro researcher in the nanomol lab at the ICMAB / ARTUR MARTÍNEZ



The ICMAB researcher Mariano Campoy-Quiles. / PAU FRANCH

is transported via cable and to generate ultrahigh magnetic fields for energy devices (wind generators, fusion magnets, efficient electrical motors for airplanes). To achieve this, Puig and her team have been working "with high temperature superconductors, which are materials exhibiting zero resistance and levitating properties, at liquid nitrogen temperatures, and therefore they ensure electricity transportation without losses and the generation of magnetic fields which could not be envisaged before." At the moment, the production of these superconductors is still of high cost, and this is what limits its widespread use. Teresa's group is working on producing these materials

using low cost and high throughput chemical methods that will be able to fabricate these materials a hundred times faster than existing methods.

The Foremat project, headed by **Mariano Campoy-Quiles** from the Nanostructured Materials for Optoelectronics and Energy Harvesting group, is also a project of the European Research Council focused on paths towards a more energy-efficient society. Campoy's team has focused on solar panels. Specifically, they have developed a platform to combine various processing methods to obtain different photovoltaic films by slightly altering parameters like its thickness, the ingredients used or its



Teresa Puig's team looks for ways to diminish the energy wasted when it is transported via cable and to generate ultrahigh magnetic fields for energy devices

nanostructure. By changing them progressively, and in Campoy's words, "what you get is a kind of plaque, in which we see the results of the same operation, but with a slight alteration in one or two of the parameters, so we can find the optimum conditions".

Mariano Campoy-Quiles has also been heading another EU-funded project called Orgevine, the acronym for Organic thermoelectric Generators to power precision Viticulture sensor Networks, where sensors are put in place in vineyards to monitor closely the crop, in an exercise of precision farming. Their source of energy is quite surprising: the sensors obtain their electricity from the changes of temperature in the soil where they are implanted.

Not all the H2020 are focused only on research: some funded projects, especially those within the Marie-Sklodowska Curie Actions programme, focus on training young researchers, such as the Doctoral Training Program on Advanced Functional Materials or other Innovative Training Networks projects.

Even though the Horizon 2020 is -quite obviously- behind us, the European Union has put in place a new funding programme: Horizon Europe, running up to 2027. The ICMAB will undoubtedly be looking forward to a new batch of projects in this new programme. ●