

Expression of Interest

Contact Person/Scientist in Charge

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Universidad de Alicante

Department / Institute / Centre

- **Name of institution:** Institute of Organic Synthesis
- **Address:** Carretera Alicante - San Vicente
- **Province:** Alicante

Research Area

- Chemistry (CHE)

Brief description of the institution:

The University of Alicante (UA) was created in 1979. Today it educates and trains more than 36.000 students -2.500 of them are international students - and offers more than 80 undergraduate and 96 postgraduate programmes: consequently it is proportionally one of the fastest growing universities in Spain. The UA houses 227 research groups in Social and Legal Sciences, Experimental Sciences, Technological Sciences, Human Sciences, Education and Health Sciences and 15 Research Institutes (Water & Environment, Materials, Electrochemistry, Biodiversity, Chemical Processes and Organic Synthesis, and Modern Languages, among others). Thus, the UA employs over 2.400 researchers/ professors and has a complex management /administration structure of 1.300 people, which involves an annual budget of 175 million Euros.

UA is a young and dynamic university with vast experience in implementing EU funded projects in different programmes and areas, with presence in more than 60 countries worldwide. In the last 10 years, UA has successfully acted as coordinator of many Tempus, Alfa, Edulink projects involving Third Countries and Lifelong Learning and Framework Programme (FP, DG Research) Projects. Moreover, the participation in FP has been increasing in the last years, taking part in 25 5th FP, 26 6th FP, 45 7th FP projects (13 of them coordinated by UA), and 6 in H2020.

It is worth underline the big effort performed by UA in order to meet the commitment with the principles set out in the European Charter for Researchers and in the Code of Conduct for the Recruitment of Researcher

Brief description of the Centre/Research Group:

The Institute of Organic Synthesis (ISO) was established as a University Research Institute in October 2003, with the aim of developing research activities of excellence in the area of organic chemistry, also looking for an application of the results of basic research to technological development.

The ISO also intends to provide technical advice, encouraging the interaction with other public and private entities directed to some fruitful ways of cooperation. It also actively participates in the training of researchers through the Doctoral Programme in Organic Synthesis, being its management centre.

The ISO is able to develop research projects related to the pharmaceutical and food industries, fragrances and cosmetics, dyes and paints, polymers, agrochemicals and petrochemicals, and natural products, among many others.

Our Institute is integrated into the UA (University of Alicante, Campus of San Vicente del Raspeig) and is equipped with an infrastructure, instrumentation, technology, electronic and human resources, enabling the development of any project related to organic synthesis. In this respect, the ISO benefits of specially reduced rates offered by the Research Technical Services of the UA (SSTTI) and the operation of a pilot plant. The latter is equipped with facilities (scale-lab and up to 250 L reactors, etc.) which allow to scale-up any given research project. Therefore, it is possible to study how feasible is for a project to be transferred to the productive sector. Activity in this pilot plant is under certification by international standards ISO9001:2015, ISO14001:2015 and cGMP, which guarantee the quality of the production with a low environmental impact. The staff is composed of fourteen Researchers (ten full Professors), all highly qualified doctors belonging to the permanent staff of the UA, about twenty-five students which are trained in different research units, and some technicians devoted exclusively to projects with private companies.

In addition, the ISO has three Honorary Researchers: Prof. Elias J. Corey (Harvard University, Nobel Prize in Chemistry 1990), Prof. Ryoji Noyori (Nagoya University, Nobel Prize in Chemistry 2001) and Prof. Irina P. Beletskaya (Academician of the Russian Academy of Sciences), all appointed Dr. Honoris Causa by the UA. The total of theses presented in the period 2013-2018 under the direction of said researchers has been 32. All of them have participated in three or more R & D projects of regional, national or international scope. Numerous projects have also been developed in collaboration with companies (about 25 projects in 2013-2018). The scientific production of the ISO in the period 2013-2018 includes 220 international publications and 8 patents.

Webs of interest: ISO: <https://iso.ua.es/>

Doctoral Programme in Organic Synthesis: <https://iso.ua.es/es/doctorado-en-sintesis-organica/pd-en-sintesis-organica.html>

Project description:

The research group is interested in photoredox homogeneous and heterogeneous catalysis. The cross dehydrogenative coupling (CDC) has recently emerged as a powerful synthetic tool that allows the formation of C-C bonds from two C-H bonds of different substrates.

In general, the CDC reactions involve catalysts in the presence of a stoichiometric oxidant. However, the expensive metals used, their difficult recycling, the narrow substrate scope, the necessity of stoichiometric amounts of oxidising reagents and the environmental impact of the reaction media are some of the factors that curtail a more efficient exploitation of these reactions. Modern research and chemical production must be based on sustainable and environmentally benign practices. The present project is aimed to develop new catalytic systems based on heterogeneous photoredox catalysis with visible light, that allow to overcome the aforementioned inconveniences, as well as their exploitation to face new synthetic challenges. In general, sustainable methodologies involving the use of renewable sources, cheap, versatile and reusable catalysts, operating under environmentally friendly and mild reaction conditions are pursued.

The study is tackled with the knowledge of the members of our group of CDC reactions and photoredox catalysis through four different fronts:

- (1) plasmonic photocatalysis on photocatalytically inert supports;
- (2) monometallic or bimetallic metal nanoparticles on nanostructured supports and visible radiation;
- (3) multimodal visible heterogeneous photocatalysis with different catalytic configurations;
- (4) heterogeneous photocatalysis using organic dyes as photosensitizers.

The specific objectives proposed to be reached through the above four catalytic strategies are:

- The formation of C-C bonds (with different types of hybridisation) by activation of C-H bonds adjacent to N through CDC reactions.
- The formation of C-C bonds by activation of C-H bonds adjacent to O through CDC reactions.
- The development of methodologies for asymmetric CDC reactions, taking advantage of the wide experience of members of our group in asymmetric synthesis (including asymmetric organocatalysis).

The expected results are:

- ❖ To obtain a series of reusable heterogeneous catalysts with high photocatalytic activity, which operate under mild reaction conditions under visible (or solar) irradiation.
- ❖ To be able to modulate the activity/selectivity of the catalysts with the type of support, the presence of metal nanoparticles (and their oxidation state) or organic dyes, as well as with the incorporation of a second metal or organocatalyst.
- ❖ To synthesize a wide variety of nitrogenated and oxygenated compounds of great interest in a straightforward, selective and efficient manner.
- ❖ To obtain chiral non-racemic compounds through asymmetric CDC reactions using the above catalytic strategies in combination with chiral auxiliaries and organocatalysts.

Applications

CV and Letter of motivation
Deadline 31 July, 2019