Expression of Interest

Contact Person/Scientist in Charge

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Universitat Jaume I de Castellón (UJI)

Department / Institute / Centre

- **Name:** Department of Physical and Analytical Chemistry / Universitat Jaume I de Castellón (UJI)
- **Address:** Av. de Vicent Sos Baynat, s/n 12006
- **Province:** Castellón

Research Area

- Chemistry (CHE)
- Physics (PHY)

Brief description of the institution:

Universitat Jaume I de Castellón (UJI), is the public university in the north of the Valencian Community, created on 1991. It has obtained the 500+ Golden Seal of European Excellence by the Excellence in Management Club.

The UJI offers 31 undergraduate degrees, 19 postgraduate studies, 43 official postgraduate master's degrees, 15 UJI-specific master's degrees and has 14,000 students. It counts on about 1000 researchers distributed in 27 university departments and 12 research institutes.

The UJI is the third University and fifth entity of the Valencian Community, including companies and other research institutes, which have obtained more money from the European Research and Innovation Framework Programmes. Currently it is involved in 26 ongoing European research actions, including several European programmes (such as H2020, FP7, Interreg, SUDOE, LIFE, etc.).
The UJI offers modern research facilities among which stand out the different scientific structures that

support research, such as the Central Scientific Instrumentation Service, the Animal Experimentation Service (SEA) or its prestigious Library.

A specific program for newcomers helps researchers with the administrative procedures in order to become familiar with the facilities and standard practices, as well as an accurate integration. Moreover researchers can access additional services such as Sports Service, The University Residence, the Language Learning Centre (CAL) that offers an annual program of languages for foreigner researchers and the health centre available to the University community.

Brief description of the Centre/Research Group (including URL if applicable):

The Quantum Chemistry Group of University Jaume I (http://quimicaquantica.uji.es/) is led by Prof. J. Planelles, with two permanent staff researchers and a few PhD or postdoc fellows. Our expertise lies in the fields of theoretical Solid State Physics and Quantum Chemistry.

We investigate the fundamental electronic and optical properties of novel semiconductor nanostructures. Our task is to elucidate the main physical mechanism ruling their behaviour. Then we develop computational methods to simulate, understand and predict their behaviour, in close collaboration with our experimental partners. Our main areas of research at present are: i) optics of semiconductor nanocrystals and ii) charge and spin dynamics in quantum dots.

A few selected publications:

1. Nature Comms 6, 7905 (2015). “Band structure engineering via piezoelectric fields in strained anisotropic CdSe/CdS nanocrystals”

2. Phys Rev B 92, 041302(R) (2015). “Symmetry-induced hole-spin mixing in quantum dot molecules”

3. ACS Nano 7, 2443 (2013). “Two-photon-Induced Blue Shift of Core and Shell Optical Transitions in Colloidal CdSe/CdS Quasi-Type II Quantum Rods”

Project description:

Colloidal nanocrystals are nanoscopic-sized semiconductors usually embedded in a liquid matrix or deposited on surfaces. Because of their excellent optical properties, tunable emission wavelength, room temperature operation and low cost of fabrication, they have been intensively studied in the last decades and recently reached mass market applications in LED screens. Other devices are expected to follow once the fundamental processes governing its optical properties are mastered.

Among the latest landmark discoveries is the synthesis of nanoplatelets (NPs), nearly two-dimensional sheets of II-VI semiconductors which are the colloidal equivalent of epitaxial quantum wells developed in the 80-90s. The quasi-2D nature of these structures provides them with distinct opto-electronic properties,

including ultra-fast exciton radiative recombination, strongly suppressed non-radiative recombination and narrow band width, all of which render NPs very attractive for improved optical devices.

Over the last 5 years, the interest on NPs has translated into an increasing experimental studies. By contrast, theoretical studies are scarce and often fail to capture the distinct features of 2D systems. For example, it has been recently shown (PRL 116, 116802) that the recombination rate of p-shell excitons is faster than that of s-shell ones. This is counterintuitive, and a theoretical explanation is missing.

The goal of the present project is to build a model which correctly captures the strong electronic correlations of excitons to properly describe and predict the photophysics of NPs with different dimensions, material composition and crystal structure. The work will be carried out in collaboration with our experimental partners in IIT Genova and/or TU Berlin.

Applications

Please, submit the next documentation:

- CV

- Two reference letters

Deadline: 30/06/2016