International Doctoral Program in Science Position

Colloidal nanoscale heterostructures for catalytic and optoelectronic applications

Background and motivation

The project aims to develop nanoscale heterostructures based on colloidal chemical approaches. The combination of different materials constituting such heterostructures will enable a fine control over the photoluminescence emission and/or carrier separation & dynamics for applications that can range from light emission, catalysis to memristors.

Important steps of the project are the identification of suitable combinations of materials (also via modeling of the electronic properties), followed by their synthesis, characterization, and exploitation in devices. A critical aspect of the work will also be to engineer the heterointerface between materials at the nanoscale in order to prepare low-strain interfaces.

The target applications will determine the material design. In the case of catalytic applications, colloidal heterostructures should be designed in order to achieve a synergistic effect between component materials. This in turn can lead to different advantages: i) boosting the catalytic activity of the active material in the heterostructure; ii) increasing the catalyst stability; iii) allowing for a higher selectivity (the formation of a desired product with respect to other possible undesired side products); iv) increasing the range of possible catalytic products. On the other hand, heterostructures in which, for example, a shell material is grown on the top of a core material enhancing the carriers recombination in the latter, can be exploited in light emitting diodes and lasers.

Finally, one possible future direction would be the synthesis of materials whose electronic behavior can be on/off triggered via light absorption. In this way the local change of electronic would allow a resistive switching behavior by means of complete light control to be applied in memristors.

Applications in catalysis and light emission will be carried out at the Italian Institute of Technology (IIT) in Genova (supervisors: prof. Liberato Manna and Dr. Luca De Trizio) and at Notre Dame University (ND) in collaboration with the group of prof. Prashant Kamat. Applications in memristors will be carried out in collaboration with the group of prof. Luca Gavioli at Università Cattolica (UCSC) in Brescia.

Profile

- Master's degree or comparable qualification in Chemistry, Materials Science or Physics. The title must be obtained before OCTOBER 31ST 2021.
- A strong interest for multidisciplinary research is required.
- Candidates should have a solid background in Chemistry, Materials Science or Physics.
- Good knowledge of the English language, both spoken and written, is essential.
- Strong commitment, ability to work in a team, and eagerness for international mobility is desired.

Opportunities

- Experimental research participating to the international collaboration between IIT, ND, and UCSC, with at least one year spent at ND.
- **Double degree opportunity (European title from UCSC and American title from ND).**
- **The fellowship co-financed by IIT and UCSC amounts to 1500 euros/month net.**

Supervisors

- Prof. Liberato Manna (IIT) Italy, Liberato.Manna@iit.it
- Dr. Luca de Trizio (IIT) Italy, Luca.detrizio @iit.it
- Prof. Prashant Kamat (ND) USA, pkamat@nd.edu
- Prof. Luca Gavioli (UCSC) Italy, luca.gavioli@unicatt.it

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