SESSION: *New trends in nanotechnology, nanostructures and nanoscience*

Preference: ORAL

Solution-processed semiconductor nanostructures for optoelectronics

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Solution processing is an accessible and versatile approach for synthesizing structurally and chemically controlled nanomaterials. The ability to control the purity, surface chemistry, and microstructure of solution-processed nanomaterials using tailored reaction chemistry and processing conditions will enable to move away from vacuum-based processes. This will reduce the cost and improve the scalability of nanomaterials and related devices, therefore meeting the increasing demand for cheaper consumer electronics. In this talk, I will present an overview of solution-based approaches my group has developed over the past few years to synthesize semiconducting nanostructures for applications in optoelectronics.

First, I will present the colloidal syntheses of highly doped semiconducting nanocrystals focusing on plasmonic metal oxides including ZnO, SnO_2 and $BaSnO_3$, discussing doping strategies, scalability, and the fabrication of nanocrystal-based thin films. The distinctive optical and electrical properties of these doped colloids will be harnessed through the fabrication of infrared absorbers, transparent electrodes and plasmonic gas sensors.

Then I will present the direct synthesis nanostructured thin films using methods including chemical bath deposition, spray pyrolysis and SILAR. I will discuss the advantages of chemical bath deposition, a water-based deposition technique that employs only cheap and widely available chemicals, and produces highly crystalline materials at low temperatures (<80 °C) with excellent control on their optoelectronic properties, enabling applications within solar cells and light emitting devices. Next, I will discuss the versatility of ultrasonic spray pyrolysis, presenting a comprehensive overview of SnO_2-based films as a model system, highlighting the synthesis of transparent conductors able to compete with commercially available products manufactured by vacuum based depositions. Finally, I will present some recent results on the synthesis of nanostructured $BiVO_4$ coatings via SILAR (successive ionic layer absorption and reaction) for application in photoelectrochemical water splitting, and of bismuth chalcohalide (BiOI, BiSI) thin films for high performance photodetectors.

[1] *Chem. Mater., 31 (2019) 9604-96130*
[2] *Chem. Commun., 79 (2019) 11880-11883*
[3] *Adv. Mater. Interfaces, 7 (2020) 2000655*

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