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Abstract

Nano-meso-macro: Hierarchical Superstructures synthesized in Bicontinuous microemulsions for electrocatalysis and SERS

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Abstract:
Statement of the Problem: Hierarchical superstructures (HSSs) are 3-D structures with a significant improvement in some properties as compared to isolated nanoparticles. However, formation of HSSs has been conducted by intricate methods that usually involve synthesis of the building blocks and the assembly in superstructures in a second step. Methodology & Theoretical Orientation: As alternative one-pot procedure, we propose the use of bicontinuous microemulsions (BCME). The channels of BCMEs have a thickness in the nanometer scale. Both water and oil channels are continuous phases, having infinite lengths. Thus, it is feasible to imagine the growth of HSS inside them, as the narrow thickness of the channels will allow the formation of nanometer building blocks, whilst their interconnection allows for the self-assembly of these nanoparticles into macroscopic 3D networks. The use of BCME for the synthesis of inorganic nanomaterials is rare, in comparison to the use of W/O and O/W ME. When BCME were used, isolated and well dispersed NPs has been obtained, mostly using ionic surfactants and water-soluble precursors. In this investigation, we used BCME based on the nonionic system water/ Synperonic 91/5 /isooctane for the synthesis of Pt, PtCo3O4, PtCoNi, and Ag HSSs. The use of both water- and oil-soluble precursors were compared. Findings: HSSs resembling nanocorals, made by interconnected NPs or nanoneedles were obtained (Pt, PtCo, PtNi, PtCo3O4), both by chemical reduction and electrodeposition. These materials were explored as electrocatalysts. On the other hand, for Ag superstructures, it was necessary to add a stabilizer (sodium citrate) in order to form a Ag HSS, which was assessed as Surface Enhanced Raman Spectroscopy (SERS) substrate, resulting in analytical enhancement factors in the order of 109 for Rhodamine 6G. These results demonstrate the usefulness of employing certain BCME for HSSs synthesis of, although the concept is not universal to all BCMEs.

Biography:
Margarita Sánchez-Domínguez received a Ph.D. in Physical Chemistry from University of Bristol in 2004. She was a postdoctoral researcher at Institute Charles Sadron (CNRS, Strasbourg, 2004-2006), and at the Institute of Advanced Chemistry

of Catalonia (IQAC-CSIC, Barcelona, 2006-2010). She joined CIMAV Monterrey (México) in 2010. She has published around 70 papers, several book chapters, one book and several patents. Her research goal is to understand the interfacial and colloidal properties of surfactant systems with the aim of using them for applications related with materials science and industrial formulations, with a particular focus on the use of bicontinuous microemulsions as confined reaction media for the synthesis of plasmonic hierarchical superstructures for their use as SERS substrates and electrocatalysts. Other interests include drug delivery and stimuli-responsive surfactant systems.

Publication of speakers:

- Margarita Sánchez-Domínguez et al; Nanoparticles for death induced gene therapy in cancer, 2017 Nov 15.
- Margarita Sánchez-Domínguez et al; Seasonal variation and chemical composition of particulate matter: A study by XPS, ICP-AES and sequential microanalysis using Raman with SEM/EDS, 2018 Feb 27.
- Margarita Sánchez-Domínguez et al; Effects of green and red light in L-crystallin and ovalbumin, 2015 Dec 14.
- Margarita Sánchez-Domínguez et al; Changes in self-assemblies induced by temperature, concentration and light, 2013 Jan 1.
- Margarita Sánchez-Domínguez et al; Micro-nanoparticles magnetic trap: Toward high sensitivity and rapid microfluidic continuous flow enzyme immunoassay, 2020 Jan 30.

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