

19th Nano Congress for Next Generation

August 31- September 01, 2017 Brussels, Belgium



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Flexible and versatile nanoparticle synthesis platform by gas-diffusion electrocrystallization

Gas-diffusion electrocrystallization (GDEx) is a new electrochemical process that conveys the synthesis of crystalline nanomaterials with well controlled and narrowly distributed properties that relate to specific functionalities. GDEx is a one-pot rapid process involving a porous cathode, an aqueous electrolyte containing metal or metalloid ions, and an oxidant gas, in which colloidal dispersions of nanomaterials or solid nanoparticles are synthesized. The general principles and mechanism through which GDEx operates will be introduced. Cerium oxide nanoparticles with controlled crystallite sizes and compositions, which result in tunable oxygen sorption capacities and kinetics, have been synthesized using GDEx. These can be tailored for pro-oxidant or anti-oxidant applications of interest for electronic packaging, oxidative stress alleviation, or cancer therapy. GDEx has also been used to produce iron oxide nanoparticles in which the ratio of hematite (Fe_2O_3) and magnetite (Fe_3O_4) can be tweaked, providing the possibility to regulate their magnetic susceptibility. These materials are studied for molecular diagnostics. Solid nanoparticles of herbertsmithite, have been obtained. These Cu/Zn-based nanoparticles may have applications in data storage, high-temperature superconductors and for so-called “quantum-entangled” batteries. Finally, when using manganese, compositions with birnessite and hausmannite — which may intercalate water and alkali metals — have been synthesized, providing promising materials for batteries electrodes or catalysts. GDEx is revealed as a new route to synthesize a wide range of nanoparticles, flexibly and with versatile control of composition, morphology, and physicochemical parameters, which in turn tailor specific functionalities.

Biography

Xochitl Dominguez Benetton completed her PhD at the Mexican Petroleum Institute. She started her early career as a Research Professor at the University of Yucatan, in Mexico, followed by Postdoctoral Research at the National Polytechnic Institute of Toulouse, in France. Currently, she is a Senior Scientist at the Flemish Institute for Technological Research where she has conducted research on Electrochemical Systems, leading to more than 40 papers in reputed journals, as well as 5 patents. She invented the process of gas-diffusion electrocrystallization, and is currently developing a wide-ranging library of functional nanomaterials.

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