

Advances in the Preparation and Application of Metal Shell Silica Core Particles

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Abstract

Dielectric colloidal particles, such as silica particles, in the nano- to micrometer range coated with noble metal shells, are well-known for their adjustable optical properties, i. e. a plasmon resonance that can be tuned throughout the whole visible and infrared region of the spectrum. These tunable plasmonic properties open the possibility for various applications in theranostics and photonics, e.g., the fabrication of photonic crystals or the plasmonic enhancement of the luminescence of organic dyes and upconversion nanoparticles. The properties of such particles can be further tuned by modifying their shape by ion irradiation, by the controlled synthesis of semi-coated colloids such as half-shell particles or by inducing plasmonic coupling by ordering them in colloidal arrays. We have recently developed a general procedure for the controlled coating of silica particles in a broad size range with full or half-shells consisting of different metals, including gold and silver, palladium, nickel, and copper. Particles coated with half-shells of the latter three metals are attractive for applications as adhesion promoters to manufacture printed circuit boards. Despite the broad field of applications for metal shell particles, they are still mostly prepared by laborious multistep wet-colloidal chemistry procedures.

First approaches with microreactors show that the application of this technique can simplify such procedures by turning them into continuous processes. As a result, it is possible to provide high control over the reaction conditions while keeping the preparation costs low. In this presentation, recent progress and concepts in synthesizing and applying metal shell-silica core nanoparticles are presented.

Biography

Christina Graf studied chemistry at the Mainz University/Germany, where she received her doctorate in 1999. Afterward, she was a postdoc at the Utrecht/University/Netherlands. She then worked at the Würzburg University/Germany and the Freie Universität Berlin, where she completed her habilitation in 2009. Afterward, she had a professorship in Physical Chemistry for five years at Freie Universität Berlin. Since 2016 she is a professor for Physical Chemistry at Darmstadt University of Applied Sciences. Her research focuses on the synthesis, functionalization and characterization of multifunctional inorganic nanoparticles, their arrangement in ordered structures and the investigation of their interaction with biological systems.