Synthesis of Solid and Hollow Metal/CeO_2 Hybrid Nanostructures

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Controllable integration of noble metals and metal oxides into single nanostructures has recently become one of the hottest research topics due to the unique structural features and synergetic optical and catalytic properties that these complex nanocrystals (NCs) possess. In quest of developing advanced functional NCs, the design of metal-oxide nanostructures has become quite sophisticated through controlling the size, shape and crystal structure of the constituent domains. Still, a long-standing barrier has been the development of simple and cost-effective synthetic processes allowing a fine adjustment of the structure and interface of these systems. Until now, a great deal of work has been performed to design and produce different nanostructures containing noble metal (Pt, Pd, Au, Ag) cores and CeO2 shells with outstanding optical and catalytic properties. However, the synthetic protocols for the production of these NCs have become considerably more and more complicated as the control of NC's morphology and architecture becomes more precise, often requiring multiple steps and exotic techniques.

Herein, we present a general approach for the preparation colloidal solutions of metal/CeO2 hybrid NCs that allow the fine adjustment of the final composition, location engineering (core/shell or heterodimer), dimensionality and surface structure of each individual domain.[1] As a result, we obtain Au/CeO2 and Ag/CeO2 hybrid NCs with precise control of their size and morphology. Moreover, by using these NCs as a template and adopting the galvanic replacement reaction to oxidize the Ag counterpart, hollow hybrid structures AgAu/CeO2, AgPt/CeO2, and AgPd/CeO2 can be prepared. The combination of noble metal and CeO2 domains in a well-defined architecture represents the possibility to tune the optical and catalytic activity and selectivity of the resultant NCs.

References

1. Bastús, N. G.; Pérez, S.; Patarroyo, J.; Genç, A.; Arbiol, J.; Puntes, V., Robust One-pot Synthesis of Citrate-Stabilized Au@CeO2 Hybrid Nanocrystals with Different Thickness and Dimensionality. *Applied Materials Today* **2019,** *Accepted*

Figures

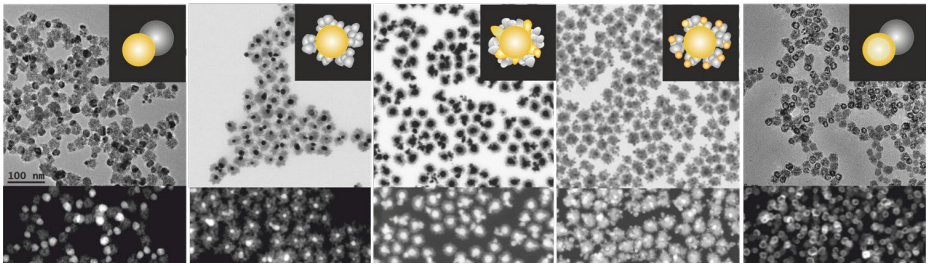

Figure 1: *Representative examples of the hybrid solid and hollow metal/CeO2 NCs produced with controlled size, shape, morphology and architecture.*