TOPOLOGICALLY CONTROLLED GROWTH OF MAGNETIC-METAL-
FUNCTIONALIZED SEMICONDUCTOR OXIDE NANORODS

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The development of colloidal hybrid nanocrystals (HNCs), in which two or more material
sections with peculiar chemical, optical, magnetic and/or catalytic properties are connected by
epitaxial interfaces, represents an emerging field of great interest in nanoscience.1 Nanocrystal
heterostructures, characterized by a topologically controlled distribution of their chemical
composition, are extremely attractive as advanced generations of nano-objects potentially able to
perform multiple tasks in optoelectronic devices, biomedical engineering, diagnostics, sensing, and
catalysis.2-10 To date, the chemical fabrication of HNCs remains a challenging task, as the ability to
tailor the size and shape of the individual material domains has to be integrated with the control
over additional parameters at the nanoscale, such as inter-compound miscibility, interfacial strain,
and facet-specific chemical reactivity.

Here we present a seeded growth approach to synthesize a novel type of colloidal semiconductor/magnetic-metal HNCs, each made of spherical ε-Co domains epitaxially attached to
one anatase TiO2 rod-shaped portion.10 We have been able to control the heterogeneous nucleation
of spherical ε-Co domains onto preformed TiO2 nanorods in suitable surfactant mixture, achieving
metal deposition on either the tips or on multiple locations along the longitudinal sidewalls of the
oxide seeds. A detailed compositional, structural, and magnetic characterization of the as-prepared
heterostructures has been carried out by combining powder X-ray Diffraction, high angle annular
dark field (HAADF) imaging, and high-resolution transmission electron microscopy (HRTEM)
analyses, superconducting quantum interference device (SQUID) magnetic measurements. Our
results suggest that the possibility of switching between either TiO2-Co HNC topologies arises from
the facet-dependent chemical reactivity of the TiO2 seeds, which is mainly governed by surface

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selective adhesion of the surfactants, rather than by misfit-related interfacial strain at the relevant junction points. These TiO$_2$-Co HNCs could find relevant applications as bi-functional, magnetically recoverable (photo)catalysts and as active elements in novel magneto-optical applications.

References

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