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Nanocrystal Chemistry within Atomic-Thin 2D-Slit-Nanospace

Over the past several years, our research has centered on the development of the Nanospace-Confined Chemical Reaction (NCCR) strategy, which exploits spatial confinement within hollow silica nanostructures to direct the synthesis and transformation of nanocrystals (NCs). By employing nanostructured silica as a well-defined reaction medium, the NCCR approach enables access to reaction pathways and chemical phenomena that are inaccessible in conventional bulk systems, while simultaneously providing versatile synthetic routes toward structurally and functionally unprecedented nanomaterials. More recently, we have extended the NCCR concept to two-dimensional (2D) anisotropic nanospaces with few-nanometer-scale thickness, herein referred to as 2D slit nanospaces. This architectural evolution has revealed distinctive evolution and conversion chemistries of confined NCs, governed critically by the atomic-scale thickness and anisotropy of the 2D confinement. In particular, we demonstrate that such extreme nanospace confinement enables the growth of highly oriented, anisotropic platinum-group metal (PGM) nanostructures with preferential exposure of unconventional crystallographic surfaces.These observations highlight the decisive role of atomic-thin 2D confinement in dictating nucleation, growth, and surface stabilization processes. Finally, we discuss how these insights can be translated into advanced catalytic and energy-related applications, where precise control over crystal orientation and surface structure is essential for performance enhancement.

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