On the Imprinting of Bulk Silica using Gold@Silica Core-Shell Nanoparticles

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Abstract

The synthesis of bulk imprinted silica using colloidal gold as a functional template is demonstrated. The imprinting approach relies on the isolation of colloidal gold in gold@silica nanoparticles synthesized via a 3-aminopropyltrimethoxysilane (APS) route. Gold@silica nanoparticles are then condensed within a silica framework for the synthesis of a composite gold-silica material containing ~30 wt% gold. Solid-state UV-Vis spectroscopy of this material shows a single surface plasmon resonance absorption band frequency corresponding to that of gold nanoparticles in dilute aqueous solution, thereby confirming the isolated nature of the immobilized imprinted sites. These immobilized gold cores are subsequently etched using cyanide for the synthesis of imprinted silica containing templated porosity, which corresponds to the space that was occupied by the gold. Each imprinted site can contain on average ~600 organized amino functional groups within the interior periphery of the templated pore. Characterization of imprinted amines was performed using probe molecule binding experiments as well as ^{13}C CP/MAS solid-state NMR spectroscopy. Altogether, these techniques show that the amount of amine incorporation within the imprinted site is less than 10% of the expected yield. Future directions for the synthesis of bulk imprinted silica using colloidal gold templates are provided, which rely on mercaptosilane functional group organization at the core-shell interface of gold@silica nanoparticles.