Title:	CdS Nanostructures with Diverse Morphology as Heterogeneous Lewis Acid Catalysts
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Abstract:	CdS is one of the semiconductor nanomaterials (band gap: ~2.42 eV) that has been exploited for its unique physical, chemical, and optical properties, notably for its good charge carrier capacity and photocatalytic activity. Additionally, CdS possesses good Lewis acidity to contend as an emerging efficient heterogeneous catalyst for organic transformation reactions. In this work, a very simple and easy-to-handle method has been utilized to fabricate diverse CdS nanostructures (CdS_1a–CdS_6a) from a mixture of {[Cd2(bpta)2(adc)2]·2H2O}n or {Cd2(bpea)2(adc)2}n (where bpta = N,N′-bis(pyridyl-t-butyl) amine, bpea = N,N′-bis(pyridylethyl) amine, and adc = acetylene dicarboxylate) and thiourea as the Cd2+ and S2– sources, respectively, in three different solvents (methanol, ethanol, and tert-butanol) under solvothermal conditions at 120 °C for 6 h. Moreover, a time-dependent evolution study was utilized for the understanding of their formation at optimized conditions. Their varied morphologies (hollow and porous) were confirmed by field-emission scanning electron microscopy (FESEM). The crystallinity and bulk phase purity of all CdS nanostructures was confirmed by powder X-ray diffraction (PXRD), energy-dispersive X-ray (EDX) spectroscopy, X-ray photoelectron spectroscopy (XPS), and high-resolution transmission electron microscopy (HRTEM). On the basis of their solid-state ultraviolet–visible (UV–vis) diffuse reflectance spectra, the band gap values in the range of 2.441–2.5 eV were calculated from the Tauc plot. Their porosity and surface area were measured by a N2 adsorption experiment. Furthermore, the emission spectra showed maximum intensity in the case of nanostructures fabricated in ethanol, followed by those fabricated in methanol and tert-butanol, respectively. Among all of the nanostructures, as-synthesized CdS_3a was found to be the best heterogeneous catalyst to prepare several bis(indolyl)methanes (BIMs) at room temperature under solvent-free conditions. The recyclability up to three cycles and the stability of the catalyst were also confirmed.
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