Title:	Solvent-Induced Diversification of CdS Nanostructures for Photocatalytic Degradation of Methylene Blue
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Abstract:	A facile template-free and surfactant-less solvothermal method under mild conditions (120 °C for 6 h) has been developed for the synthesis of rare walnut-shaped hierarchical multihollow CdS microspheres (1) in good yield from a mixture of a coordination polymer (CP) {[Cd2(bpma)2(adc)2]}n (where bpma = N,N′-bis(pyridylmethyl)methylamine and adc = acetylene dicaboxylate) as the source of Cd2+ ions and thiourea as the source of sulfide ions (with a 1:5 Cd2+ to S2– ratio) in methanol. Furthermore, a solvent effect on the diversity of CdS nanostructures is observed based on the field emission scanning electron microscopy (FESEM) analysis: hollow nanospheres (2) in ethanol, honeycomb-like porous nanostructures (3) in tert-butanol, and aggregated nanospheres (4) in water. On the other hand, only aggregated microspheres (5) were obtained in methanol if Cd(OAc)2·2H2O is used as the source of Cd2+ ions under the same conditions. This demonstrates the novelty of using a Cd(II) CP instead of Cd(II) salts in making some rare CdS nanostructures, namely 1 and 3. Using powder X-ray diffraction (PXRD), we determined the phase purity of 1–5. For 1 and 3, further structural features were established by high-resolution transmission electron microscopy (HRTEM) and atomic force microscopy (AFM) measurements. In the solid-state UV–vis diffuse reflectance spectra, 1–5 showed a blue-shift in their maxima compared to that of bulk CdS due to the quantum confinement effect that provided the band gap values of 2.57, 2.59, 2.66, 2.45, and 2.55 eV, respectively. Similarly, photoluminescence measurements showed intense blue emissions of 1–4 and green emission of 5. For the degradation of methylene blue in UV light, enhanced photocatalytic activity of 1–4 was observed compared to 5. Furthermore, 1 was also found to be reasonably efficient under dark and visible light conditions among other CdS nanostructures. To the best of our knowledge, the degradation rate of 1.19 × 10–2 min–1 for 1 is found to be faster than those for similar CdS nanostructures in the literature.
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