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Title:	Precursor- and Time-Dependent Morphological Evolution of ZnO Nanostructures for Comparative Photocatalytic Activity and Adsorption Dynamics with Methylene Blue Dye
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Abstract:	Diverse ZnO nanostructures were successfully fabricated at 700 °C by direct annealing of 1D Zn(II) coordination polymer precursors, namely, [Zn2(bpma)2(adc)2]n, [Zn2(bpea)2(adc)2]n, and {[Zn2(bpta)2(adc)2]·2H2O}n. The effect of sacrificial ligands present in the precursors as well as a variation in the retention time (6–24 h) during their synthesis resulted in 0D nanospheres, 1D microrods, and 3D polyhedra (with a diamond-like structure) of ZnO. The as-synthesized ZnO nanostructures were characterized by field-emission scanning electron microscopy, transmission electron microscopy, X-ray diffractometry, diffuse reflectance spectroscopy, and Raman spectroscopy. The hexagonal crystal structure was confirmed for all the ZnO samples. A lattice spacing of 0.22 nm has been observed for nanospheres, whereas a lattice spacing of 0.26 nm has been observed for the polyhedra. Their Raman spectra confirm the wurtzite phase of ZnO. UV–vis spectra of ZnO nanostructures exhibit broad peaks in the range of 350–370 nm, and the band gap energies are found to be in the range of 3.02–3.20 eV. Based on the photoluminescence spectra photocatalytic activities of the as-synthesized ZnO nanostructures calcined for 12 h were tested with methylene blue (MB) as a contaminant in an aqueous solution. These results demonstrate that the photocatalytic efficiency of polyhedra is higher than those of nanospheres and microrods. The adsorption kinetics of MB dye by these nanostructures were studied by three different kinetic models—Elovich's, intraparticle, and pseudo-second-order. The maximum rate of adsorption was observed with the intraparticle diffusion model.
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