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Room-Temperature Synthesis of Cuprous Oxide and Its Heterogeneous Nanostructures for Photocatalytic Applications

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Abstract

This study represents a facile but effective room-temperature strategy for the synthesis of shape/size-controlled cuprous oxide (Cu_2O) nanoparticles under mild conditions. The proposed synthesis method offers several advantages/novelties including: room-temperature processing, simple operation procedures, controllable shape and size, high yield, and available for scaling up. The effects of the pertinent variables on the particle formation and growth have been investigated, such as concentration of copper ions (Cu^{2+}), surfactants, reducing agents, and the molar ratios among variables. The composition, microstructure and optical properties were then characterized using advanced techniques. It was found that the use of different surfactants may result in significant morphology changes from spheres to octahedrons and/or wires under the reported conditions. To enhance photocatalytic performance in dye degradation, the Cu_2O nanoparticles could be further surface decorated by titanium dioxide (TiO_2) to form heterogeneous nanocomposites that can improve the electron-hole separation. This study may be useful to develop simple but general approaches to obtain cuprous/copper oxides and other hybrid semiconductor nanostructures with structure and functional control for catalysis and sensing applications.

Keywords: Cuprous oxide (Cu_2O), nanospheres, octahedrons, nanowires, heterogeneous nanostructures, photocatalysis.