Shape Evolution of Highly Uniform Colloidal Copper Nanocrystals and Their Shape-dependent Plasmonic and Electrochemical Properties

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In this report, the shape-controlled synthesis of highly uniform copper nanocrystals (Cu NCs) by the addition of *N,N*-dimethylformamide (DMF) as a shape-directing agent is presented for the first time. Colloidal Cu NCs were synthesized via disproportionation reaction of copper(I) bromide in the presence of trioctylphosphine oxide and oleylamine. The addition of DMF into the reaction mixture significantly improved the size uniformity of Cu NCs and facilitated control over their shape. With an increase in the amount of DMF in the reaction mixture, the morphology of the Cu NCs changed from a cube enclosed by six {100} facets, to a sphere with mixed surface facets, and finally to an octahedron enclosed by eight {111} facets. Further, shape-dependent plasmonic properties are systematically investigated with the highly uniform and ligand-exchanged colloidal Cu NCs dispersed in acetonitrile. Finally, the facet-dependent electrocatalytic activities of shape-controlled Cu NCs are investigated to reveal the activities of highly uniform and shape pure Cu NCs in the methanol oxidation reaction.