Morphology Evolution of Single-Crystalline Hematite Nanocrystals: Magnetically Recoverable Nanocatalyst for Enhanced Facets-Driven Photoredox Activity in organic Pollutant Degradation

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We have developed a new green chemical approach for the shape-controlled synthesis of single-crystalline hematite nanocrystals in aqueous medium. FESEM, HRTEM and SAED techniques were used to determine morphology and crystallographic orientations of each nanocrystal and its exposed facets. We also investigated the photocatalytic performance of these shaped-nanocrstyals for methyl orange degradation in the presence of visible light. In this study, we found that the density of surface Fe3+ ions in a particular facets was the key factor for the photocatalytic activity and was higher on the bitruncated-dodecahedron shape nanocrystals by coexposed {104}, {100} and {001} facets, attributing to higher catalytic activity. The catalytic activity of different exposed facets nanocrystals were as follows: {104}+{100}+{001}(bitruncated-dodecahedron)>{101}+{001} (bitruncated-octahedron)>{001}+{110} (nanorods)>{012}(nanocuboid) which provided the direct evidence of exposed facets-driven photocatalytic activity. The nanocrystals were recoverable using external magnet and reused.