Photocatalytic water oxidation with suspended Fe_2O_3 (hematite) nanocrystals

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Water splitting with a Fe_2O_3 catalyst offers an energy alternative to fossil fuels by making use of visible solar radiation. Here we systematically studied dispersed 15-35 nm Fe_2O_3 nanocrystals for photocatalytic water oxidation under visible light. Particles were synthesized by hydrolysis of $FeCl_3 \bullet 6H_2O$ for 30 minutes at 100°C in slightly acidic conditions. X-ray diffraction measurements indicate that the α-Fe_2O_3 is the present phase type, though traces of β-FeOOH contaminant were also detected. UV/Vis diffuse reflectance yield a bandgap of 2.12 eV for the nanocrystals. The water oxidation overpotential was determined using cyclic voltametry to be +0.43 V at pH 7. Over the course of 24 hours, 23.75 mg of Fe_2O_3 evolved up to 127 μmol of O_2 from 0.01 M aqueous $NaIO_4$ solution under visible irradiation from a 300 W Xe-arc lamp with a 400 nm longpass filter. The effects of ionic strength, pH, light intensity, photocatalyst amount, and sacrificial electron donor concentration on the oxygen evolution rate will also be reported.