Synthesis of ruthenium oxide nanoparticles in sub- and supercritical water and their water-splitting characteristics

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High-crystalline ruthenium (IV) oxide (RuO2) nanoparticles were synthesized in sub- (250 °C, 300 bar) and supercritical water (400 °C, 300 bar). The effect of hydroxide species and hydroxide concentration were examined. Characterization of the hydrothermally synthesized RuO2 nanoparticles by XRD, TEM, and N2 adsorption measurements revealed that high-surface-area and highly-crystalline nanoparticle can be obtained by the simple hydrothermal process. The largest surface area of RuO2 was 205.84 m2/g synthesized in subcritical condition. Meanwhile, the highest crystallinity RuO2 nanoparticle was obtained in the supercritical environment. Further measurement has been done for water splitting application. The best H2 generation rate of RuO2 nanoparticles synthesized in supercritical water was 47.1 mL/h while that of the commercial RuO2 particles was 10 mL/h.