1-D Nanoporous Iron Oxide Structure for Photoelectrochemical Hydrogen Production

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We fabricated highly (vertically) ordered nanoporous iron oxide film as a photoanode of Photoelectrochemical (PEC) cell. Iron oxide ($a-Fe_2O_3$) is a very advantageous material for visible light absorption due to its narrow band gap energy ~2.2 eV. However, this material has also fatal limitation of charge transfer originated from its short hole diffusion length (~4nm). To overcome this problem, we aimed to construct a 1-dimensionally ordered iron-oxide nanoporou structure with high crystallinity. By potentiostatic anodization technique, we synthesized 2-step anodizaed iron-oxide film followed by alumina encapsulation, annealing and alumina removal processes. After annealing and alumina removal, the phase of iron-oxide is pure hematite (obtained by XRD) which has photocatalytic activity. The prepared hematite films are also characterized by UV-visible absorption, SEM and XANES. Compared to our previous study of bulk-planar iron-oxide electrode (few tens of uA/cm^2), this photocurrent value of ordered Nanoporous iron oxide film is significantly higher. Also the morphology of this film is greatly improved through double-anodization process of iron which has not been reported by any other groups.