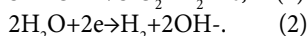
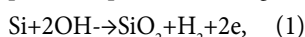


Si nanopowder for internal hydrogen generation materials

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Although Si bulk doesn't strongly react with water, Si nanopowder reacts with it when its size is less than ~20 nm, leading to generation of hydrogen. In previous literature, reactions of Si nanopowder with strong alkaline solutions have been investigated to achieve high hydrogen generation rates for application to e.g., fuel cells. In the present study, we have aimed at generation of hydrogen in internal conditions. Hydrogen generated in the body, especially in bowels, is effectively absorbed, is circulated, and reacts with hydroxyl radicals which cause various diseases such as cancer, Alzheimer's disease, Parkinson's disease, etc. Figure 1 shows the concentration of hydrogen generated by the reaction of 1 g Si nanopowder with water in the neutral pH region. Hydrogen was generated even with ultrapure water, but the generation rate was very low. The hydrogen generation rate greatly increased with pH while pH didn't change after the hydrogen generation reaction. Therefore, the reaction schemes are written as:



In the initial reaction, Si reacts with OH⁻ ions to generate hydrogen, SiO₂, and electrons most probably in the SiO₂ conduction band. In the subsequent reaction, generated electrons are accepted by water molecules, resulting in formation of hydrogen and OH⁻ ions. Reaction (1) is the rate-determining step, and thus, the reaction rate greatly increases with pH. The above result indicates that when Si nanopowder is taken, it doesn't react in stomach under acidic conditions due to gastric acid, but reacts with water in bowels in alkaline conditions because of pancreatic juice. We have performed hydrogen generation experiments under conditions similar to bowels, i.e., pH 8.3 and 36°C. In this case, more than 300 mL hydrogen was generated from 1 g Si for 20 h. This hydrogen volume corresponds to that contained in more than 17 L saturated hydrogen-rich water.

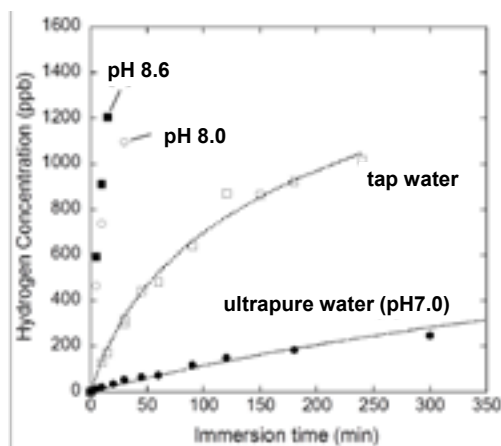


Figure 1: Hydrogen concentration in water generated by the reaction of Si nanopowder.

Biography

Hikaru Kobayashi received Doctor of Science in Chemistry from Kyoto University in 1984. He was a Post-doctoral fellow in the Physics department at the University of Pennsylvania between 1984 and 1986, and then he started working at the Matsushita Electronics Company. He became an Associate Professor of Faculty of Engineering Science, Osaka University in 1990, and moved to Institute of Scientific and Industrial Research of Osaka University as a Full Professor. He has been performing researches on fabrication of Si nanopowder, its application to hydrogen generation material, anode material in Li ion batteries, and luminescent material. He has also been studying material science related to crystalline Si solar cells, especially surface and interface control to improve conversion efficiencies.

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