Hydrogen Storage on 3.5nm Core/Shell Mg/Pd Clusters Synthesized by Combined Salt Reduction-Electrochemical Technique

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Abstract

Hydrogen energy is an ideal renewable energy for as-present and future energy sources because of its energy is highly efficient with no harmful emissions compared with fossil fuels. However, it still needs many technologies to implement, like suitable storage system. There are mainly three ways for hydrogen storage, as a high pressured gas, high cryogenic liquid, or in solid materials. Both of the high pressure and liquid phase hydrogen storage systems were considered inconvenient routs because of efficiency, safety, and economic problems, in addition to the large energy consumption in liquidation hydrogen gas and in low temperature keeping. Currently, the solid materials for hydrogen storage well on way to explore or create the most suitable material for this purpose.

Either Magnesium and palladium metals have a remarkable hydrogen uptake capacity under proper conditions. Palladium uptakes hydrogen more like the sponge when absorbing water molecules and Magnesium is considered the most promising metal for hydrogen storage material in terms of 7.6% (wt%) of hydrogen that can be up taken. Unfortunately, several drawbacks were emerged on the scene when they have been applied. Palladium is a heavy metal and magnesium has problems in hydrogen diffusion and releasing processes makes them not suite to be used as hydrogen storage materials.

The combining of the both metals (Mg & Pd) have explored a promising properties and could be the solution for their H-storage drawbacks, through catalyzing the hydrogen adsorption/desorption process for magnesium and reducing the weight by lowering the amounts of Pd in the solid matrix.

In this project, nanoparticles of Mg and Pd metals with special morphological structure, known as core/shell, was synthesized using combined salt reduction – electrochemical technique, and the hydrogen storage capacity were investigated by studying the absorption and desorption behavior of both Pressure-concentration-temperature isotherm (PCT) and kinetics kind of view using Gravimetric analysis of high-vacuum electronic microbalance.