Facile fabrication of ultrathin carbon layer encapsulated air-stable Mg nanoparticles with enhanced hydrogen storage properties

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Facile fabrication of ultrathin carbon layer encapsulated air-stable Mg nanoparticles with enhanced hydrogen storage properties

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Abstract

In this work, we present a facile way to fabricate ultrathin carbon layer encapsulated air-stable Mg nanoparticles (Mg@C NPs) by methane plasma metal reaction method. Compared with pure Mg NPs, the carbon layer can not only reduce particle size but also prevent Mg from oxidation. By adjust methane from 10 to 300 ml, average size of Mg@C NPs reduces from 140 to 60 nm and thickness of carbon layer increases from 1 to 4 nm. After exposure in air for 3 months, little MgO can be detected in Mg@C NPs. In these Mg@C samples, Mg@C (CH_4:50ml) with size of 80 nm and ultrathin amorphous carbon shell of 3 nm shows the highest hydrogen capacity of 6.3 wt% H_2. In comparison, the hydrogen capacities of Mg@C (CH_4:10ml) and Mg@C (CH_4:300ml) are only 5.4 wt% H_2 and 4.3 wt% H_2, respectively. Mg@C (CH_4:50ml) also displays the highest hydrogenation and dehydrogenation rates which can absorb 4.8 wt% H_2 within 10 min at 573 K and desorb 5.0 wt% H_2 within 20 min at 623 K. The apparent energies for hydrogenation