MAR11-2010-000776

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

$NaAlH_4$ – Carbon Aerogel: Kinetic Enhancement of a Complex Hydride by Nanoporous Carbon

FREDERICK PINKERTON, General Motors R&D Center

Complex hydrides promise high gravimetric and volumetric hydrogen storage densities, but considerable modification of their thermodynamic and kinetic properties will be required in order to make them feasible for on-vehicle applications. Catalyst additions to achieve fast hydrogen cycling kinetics have been studied for more than a decade. More recently, the concept of nanoconfinement has been explored as a means to improve kinetics, using melt infusion or solvent infusion to embed the hydride into nanoscale pores within a solid. We have achieved enhanced kinetic performance and reversibility of $NaAlH_4$ incorporated into nanoporous carbon aerogel by melt infusion, even in the absence of a catalyst. In fact, hydrogen cycling of uncatalyzed $NaAlH_4$ in aerogel is almost as good as unconfined $NaAlH_4$ catalyzed by addition of $TiCl_3$. It remains challenging, however, to obtain $NaAlH_4$-carbon aerogel infusions with high hydride loading and/or co-incorporated catalyst. We have therefore investigated combining $NaAlH_4$ with carbon aerogel and nanoporous activated carbon by ball milling. The kinetic performance is similar to that of melt-infused $NaAlH_4$ at the same loading, and importantly, higher $NaAlH_4$ loading can be easily achieved with only modest loss of kinetics. Furthermore, $TiCl_3$ catalyst can be easily co-incorporated. In the latter case, a small but significant improvement over $TiCl_3$-catalyzed $NaAlH_4$ without carbon is observed.