CORRELATION BETWEEN SIZE AND HYDROGEN STORAGE PROPERTIES OF MAGNESIUM NANOCRYSTALS PREPARED FROM SOLUTION

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Production of H_2 by photocatalytic water-splitting offers a potential renewable source of fuel for a hydrogen economy.[1] For H_2 to be practical for fuel cell use in transportation applications, however, improved methods of H_2 storage that can allow reversible storage under moderate conditions are necessary.[2] MgH_2 is a promising material for storing hydrogen due to its high H_2 weight percent and H_2 density, but its slow kinetics and unfavorable thermodynamics has limited its applicability.[3] Recent research has shown that the rate of and temperature required for H_2 absorption/desorption can be significantly improved by reducing the Mg/MgH_2 grain size through mechanical milling.[3] As an alternate preparation method, here we synthesize magnesium nanocrystals from solution with diameters that can be varied from 15 nm to 50 nm. Hydrogen sorption experiments of these nanocrystals show a dramatic increase in H_2 sorption kinetics with a decrease in diameter, as presented in Figure 1. The smallest 15 nm magnesium nanocrystals can absorb greater than 5 weight percent H_2 in 1-2 minutes at 300 °C, among the fastest kinetics for H_2 absorption by pure Mg. These data provide important guidelines for the grain sizes of metal-hydrides that are necessary to achieve desired H_2 sorption kinetics.

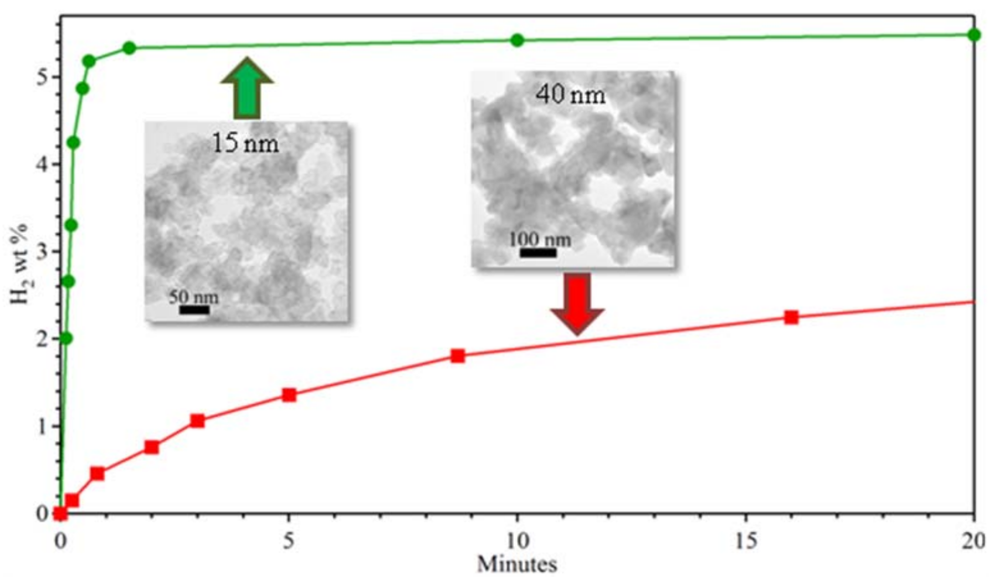

Figure 1. H_2 absorption kinetics at 300 °C and TEM images of magnesium nanocrystals with average diameters of 15 nm and 40 nm.

1. Gratzel, M., *Nature* **2001**, 414, 338.
2. Schlapbach, L.; Zuttel, A., *Nature* **2001**, 414, 353-358.
3. Zaluska, A.; Zaluski, L.; Strom-Olsen, J. O., *J. Alloy. Compd.* **1999**, 288, 217-225.