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A Variety of Metal-N-H System for Hydrogen Storage

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Metal nitrides and imides exhibit strong affinity towards hydrogen molecules. Such strong interactions enable these substances to be used as potential materials for hydrogen storage. In the previous investigations, maximum of 11.5wt% and 7.0 wt% of hydrogen storage capacities have been determined in lithium nitride and lithium imide, respectively. However, relatively high operating temperatures place a serious restriction onto the application of those substances. It is clear that to lower down the operation temperatures the composition and structure of the subject material have to be altered in order to sit within a suitable thermodynamic range. Successful attempts have been made by introducing Mg or Ca into the Li2NH binary system, in which considerable reduction in hydrogen absorption and desorption temperatures and uprising H2 desorption plateau pressures have been achieved. Ternary imide Li2MgN2H2, as an example, could reversibly store 5.8wt% of hydrogen at 180C with desorption plateau pressure higher than 10 bars. Previous investigations reveal that the hydrogen-rich phase of Li-N-H and Li-Mg-N-H systems comprise of metal amides and hydrides. It is probably the great potential for the union of $H^{\delta+}$ in amide and $H^{\delta-}$ in hydride to H2 that drives the two chemicals to react and give out hydrogen. According to this hypothesis, a serial of new Metal-N-H systems can be developed by reacting various amides with hydrides. Interaction between amide of Li or Mg with LiAlH4, MgH2, NaH and CaH2, respectively, has been investigated by an in situ planetary ball mill, TPD, volumetric Release-Soak techniques and FTIR etc. Novel Metal-N-H systems have been developed accordingly, among which three systems can release substantial amount of hydrogen (more than 5.0wt%) near ambient temperature..