B1-1
Metal borohydride-based reversible hydrogen storage

In this study, metal borobydrides and their composites with other metal hydrides whose reversible hydrogen storage capacity is higher than 8 wt% will be synthesized, and the basic sorption properties will also be characterized. The details of the final targets are:

- Reversible gravimetric & volumetric storage density : > 8 wt%, > 100 kgH_2/m^3
- Dehydrogenation/hydrogenation conditions: < 300℃, between 1 & 100 bar H_2
- Hydrogenation reaction kinetics : > 90 % of maximum capacity in 1 hour
- Cycle life : > 70% of initial capacity after 100 cycles

Goal

Synthesize and improve the sorption properties of metal borohydrides and their composites with > 8 wt% hydrogen storage capacity

- Synthesis, characterization, & improvement in sorption properties of metal borohydrides
  - Synthesis and characterization of thermal decomposition behaviour of metal borohydrides
  - Prediction of decomposition reaction by ab-initio and thermodynamic calculations
  - Study on destabilization, hydrogenation kinetics, and cycle performance
  - Analysis and control of microstructure for improving sorption properties
  - Study on hydrogen sorption mechanism at surface of metal borides
- Synthesis and characterization of sorption properties of reactive hydride composites
  - Improvement of sorption properties of metal borohydrides by adopting Reactive Hydride Composites (RHCs)
  - Microstructure analysis and improvement in sorption properties
  - Improvement in cycle performance by optimizing hydrogen sorption reaction

Objective

- 1st year
  - Synthesis of metal borohydrides with > 8 wt% storage capacity
  - Evaluation of hydrogen sorption properties
- 2nd Year
  - Synthesis of reactive hydride composites including metal borohydrides
  - Evaluation of hydrogen sorption properties and improvement of cycle performance
- 3rd Year
  - Improvement in hydrogenation reaction kinetics with catalytic additives
  - Analysis and optimization of microstructure for improving cycle performance
- 4th Year
  - Long-term sorption cycle test and enhancement of cycle performance
  - Demonstration of lab-scale storage tank with metal borohydrides

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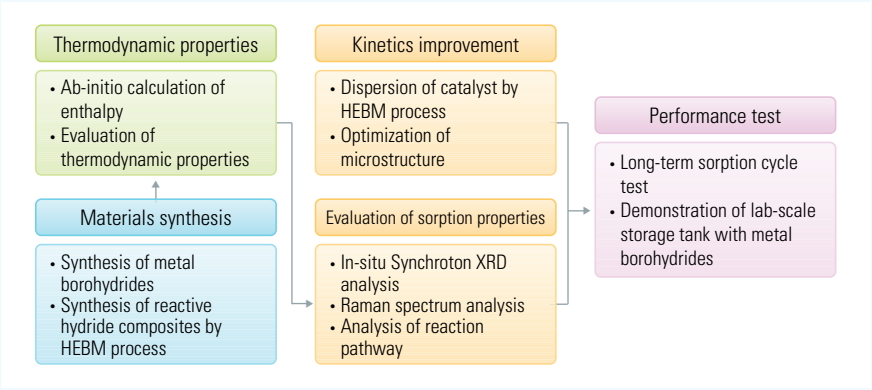
Strategy



Outcomes & benefits

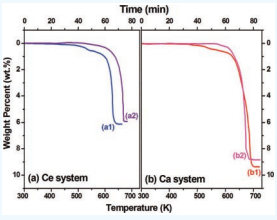
- Development of high storage capacity materials and property enhancement techniques
- Application to mobile and stationary hydrogen storage systems for fuel cells
- Application to hydrogen storage systems for internal combustion engines
- Long-term mass power storage systems for renewable energy systems
- Application to heat storage systems

Publications (2nd stage)

Patent		Theses							Proceedings		
		domestic			foreign			total sum			
domestic	foreign	SCI	Non SCI	sum	SCI	Non SCI	sum		domestic	foreign	sum
4/4	2/0				9		9	9	2	6	8

Publications

1. Sun-Ah Jin, Young-Su Lee, Yoonyoung Kim, Jae-Hyeok Shim, Young Whan Cho, "Reversible hydrogen storage in $LiBH_4$-MH_2 (M = Ce, Ca) composites", J. Phys. Chem. B, 112, 9520-9524, 2008.
2. Jae-Heon Kim, Jae-Hyeok Shim, Young Whan Cho, "On the reversibility of hydrogen storage in Ti- and Nb-catalyzed $Ca(BH_4)_2$", J. Power Sources, 181, 140-143, 2008.
3. Jae-Hyeok Shim, Ji-Woo Kim, Young Whan Cho, Method for manufacturing transition metal boride powder, US Patent 7,541,013.



$LiBH_4$+CeH_2/CaH_2 RHCs

KIST/PAL Beamline 10B(In-situ measurement)