Next Generation Car –
Coupled Thermochemical Reactions for Preheating Vehicle Components

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Operation Principle

\[ MH_{x+y} + \Delta H \rightleftharpoons MH_x + \frac{y}{2} H_2 \]

- endo-/exo-thermal reaction of metal hydride with hydrogen
- closed system: thermally driven hydrogen exchange between two metal hydrides, no hydrogen released or required (Fig. 1)

Advantages of proposed thermal energy storage

- storage free of loss as long as required
- (storage as chemical potential)
- heat generation from ambient temperature on demand
- generation of both heat and cold at the same time
- usage of waste heat => cooling effect at peak load phases
- high thermal power values possible
- low charging temperature and still high energy density of 600 kJ/lMH (150 kJ/kgMH)

Experimental Results [1]

- high thermal power tube bundle reactors
- 960 g of LaNi4.85Al0.15 (for heat generation)
- 615 g of Hydralloy C5 (for cold generation)
- experiments at temperature as low as -20°C

\[ P = \dot{m}_{HTF} c_{p,HTF} (T_{HTF,out} - T_{HTF,in}) \]

Figure 1. Van’t Hoff plot of two different metal hydrides A and B.

Figure 2. Picture and layout of test bench and the reactors.

Figure 3. Thermal power over time at different ambient temperatures.

Highest thermal power with metal hydrides at low temperatures:
- 2.4 kW/lMH (0.6 kW/kgMH) @ -20°C
- 6.4 kW/lMH (1.6 kW/kgMH) @ +20°C