

# Thermag VIII – International Conference on Caloric Cooling

## Invited Talk

### High Efficiency Magnetic Refrigeration Enabling Economical and SAFE Hydrogen Storage

Robin Ihnfeldt<sup>1</sup>, Dr. Xia Xu<sup>1</sup>, Eunjeong Kim<sup>2</sup>, Prof. Renkun Chen<sup>2</sup> and Prof. Sungho Jin<sup>2</sup>

<sup>1</sup> General Engineering & Research; <sup>2</sup> University of California-San Diego

Despite users finding that fuel cell vehicles provide a wide range of benefits including low-to-zero emissions, high efficiency, reliability, and quiet operation, their widespread adoption has been slow due to fuel pricing and lack of infrastructure. The transportation and storage of hydrogen fuel is cheaper and safer in liquid form, but getting it into liquid form and keeping it in liquid form is not easy. Energy requirements even at large scale for compression based liquefaction plants are too high, effectively preventing competitive fuel pricing. Additionally, boil-off losses at fueling stations creates a logistical nightmare that inhibits scaling and makes building a fueling station to service higher capacity future demand incredibly risky as larger onsite LH<sub>2</sub> storage also means larger daily losses. If hydrogen infrastructure cannot scale, it will never be economically competitive with gasoline.

Magnetic refrigeration is a promising technology with predicted efficiencies >50% of Carnot for hydrogen liquefaction reported by Pacific Northwestern National Lab (PNNL). There are several issues that need to be solved before the technology of magnetic refrigeration can move forward from prototypes to mass production. At GE&R we are working to bridge the gap between material science and engineering application. We have discovered novel low cost high performance MCE materials, which will be commercially available in our webstore ([www.geandr.com](http://www.geandr.com)) by end of 2018, and we are using these materials to develop a high efficiency magnetic refrigeration system specifically for liquid hydrogen storage (patents pending). Figure 1 shows the magnetization versus temperature for some of GE&R's high performance MCE materials. This presentation will summarize our material and device efforts to date.

