**Thermochemical energy storage materials for high-temperature concentrated solar energy**

Marco Gigantino1, Aldo Steinfeld1\*

 *1 Department of Mechanical and Process Engineering, ETH Zurich, 8092 Zurich, Switzerland*

*\*Corresponding author: aldo.steinfeld​@ethz.​ch*

**Highlights**

* High-temperature heat was stored via the SrCO3/SrO and CuO/Cu2O cycles.
* MgO and YSZ were selected as support framework to diminish thermal sintering.
* Preparation methods affected the cycling performance.
* Stable energy density was achieved over 100 consecutive cycles.

**1. Introduction**

Thermochemical energy storage (TCS) employs reversible endothermic/exothermic chemical reactions to store/release heat delivered by concentrated solar energy systems, thus overcoming solar radiation intermittency and enabling round-the clock dispatchability of high-temperature process heat. The TCS approach is considered attractive since it can achieve higher energy densities than sensible and latent energy storage [1]. Several metal oxides which undergo gas-solid reactions are suitable materials for high-temperature TCS systems (>600°C), but very often they exhibit a decreasing extent of conversion (directly related to the energy density) over consecutive charging/discharging cycles due to sintering. Of special interest are the SrCO3/SrO and CuO/Cu2O cycles that store heat at around 1000°C.

**2. Methods**

To tackle sintering and maintain cycling stability, sintering-resistant materials MgO and YSZ were incorporated into SrO and CuO, respectively, by means of various mixing methods, namely: dry-mixing, wet-mixing, co-precipitation and sol-gel. The resulting SrO-and CuO-based materials were tested over multiple consecutive charging/discharging cycles in a thermogravimetric analyzer.

**3. Results and discussion**

The specific thermal energy storage capacity and cyclic stability over multiple carbonation-calcination cycles was systematically investigated by thermogravimetry for different precursors, sintering-resistant additive contents, mixing methods, operating and pre-treatment conditions.

**4. Conclusions**

Full stability over 100 consecutive charging/discharging cycles was achieved for a MgO-stabilized SrO-based material (40 wt% SrO) and a YSZ-stabilized CuO-based material (65 wt% CuO) with values of gravimetric energy densities of 0.81 MJ/kg and 0.56 MJ/kg, respectively.

**References**

1. P. Pardo, A. Deydier, Z. Anxionnaz-Minvielle, S. Rouge, M. Cabassud, P. Cognet,. A review on high temperature thermochemical heat energy storage. Renew. Sustain. Energy Rev., 2014