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High-performance thermochemical energy storage with transition metal ammoniates on a matrix

REFERENCE:
M020/2016

DEVELOPMENT STATUS:
Proof of concept

KEYWORDS:
- High energy density
- Rapid temperature increase
- Matrix support
- Transition metal ammoniate
- Thermochemical energy storage

IPR:
Austrian patent application submitted

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BACKGROUND

Based on the global trend towards a renewable and responsible energy economy, politics and industry encourage the development of a sustainable energy management. One approach within this context is thermochemical energy storage, focussing on recyclability of waste heat. Thermochemical energy storage is based on a reversible chemical reaction featuring a preferably high reaction enthalpy. Thermal energy is loaded to the system during the decomposition reaction (charging cycle), whereas the exothermic back-reaction releases the stored energy (discharging cycle).
Transition metal salts as copper sulfate react with ammonia reversibly under notable release of thermal energy, featuring an initial temperature increase beyond 350 °C within seconds. Technological implementation of such systems would be ideal for applications where a rapid temperature increase is requested, going along with limited availability of space.

TECHNOLOGY

Dealing with issues as material costs and weight, as well as particle sintering and notable volume changes from charging- to discharging reaction, the development of matrix-based ammoniate storage materials allows to circumvent these issues with concomitant retention of cycle stability, proportional energy content and reaction kinetics. The slightly decreased peak temperature is still highly attractive, allowing applications as *e.g.* preheating of a car catalyst to decrease pollutant emission on cold starts.

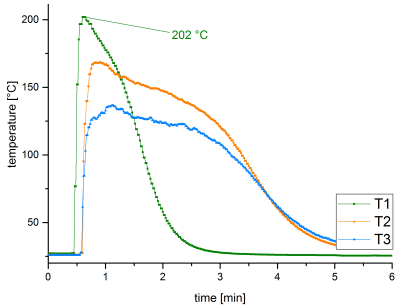

Figure 1: Temperature profile for the reaction of NH_3 with $CuSO_4$ on zeolithe

Figure 2: $CuSO_4$ on zeolithe

BENEFITS

- High initial peak temperature
- High energy density, fast reaction kinetics
- Perfect cycle stability
- Elimination of sintering, melting and volume changes

APPLICATIONS

- Industrial processes
- Custom-tailored solutions
- Heat-source for process integration
- Link between exhaust heat and district heating

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