TECHNOLOGY OFFER

MICROFLUIDIC THERMAL ENERGY REACTOR AND STORAGE

To overcome the temporal imbalance between supply of and demand for thermal energy, TU Wien scientists have developed a flexible, modular, and scalable thermal energy storage system: the combination of lab-on-a-chip technology (microfluidics) with reversible solid-gas-reactions allows for short- or medium-term thermochemical energy storage for e.g. industrial waste heat recovery and (concentrated) solar power plants.

BACKGROUND

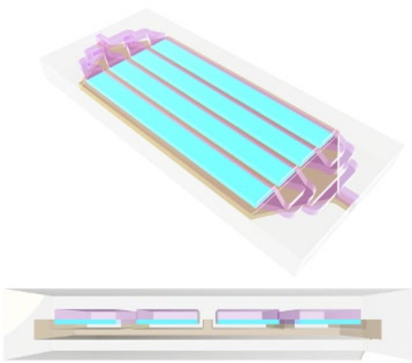
Most industrial processes generate heat as a by-product. This thermal energy is often not utilised and is lost. Other processes within the production line, on the other hand, require thermal energy. Overall, large amounts of energy are required, while there is little to no energy recycling in industrial production processes. Partly this is because current heat storage systems (latent and sensible) often require large amounts of heat storage material or are not suitable for the required temperature ranges and the energy cannot be released when required.
Thermochemical energy storage offers a solution for industrial applications, as the energy storage to volume ratio is significantly higher compared to existing systems, required temperature ranges can be accessed and energy can be released on demand by controlling the speed of the chemical reaction.

Among the most promising systems is the interaction of copper sulphate ($CuSO_4$) with ammonia, which leads to an exothermic reaction. However, by applying heat, the reaction can be reversed, removing the converted ammonia and recharging the system.

TECHNOLOGY

In our newly developed system, thermal energy is stored in $CuSO_4$ in a microfluidic device, allowing precise control of the chemical reaction and long-term storage of the energy introduced.

$CuSO_4$ is embedded in a support matrix comprising a gas-permeable elastomer (PDMS) and placed within the device. The material is enclosed by a system of ducts through which ammonia gas is directed onto the substrate, triggering the reaction.
On the opposite side of the device, a second system of channels allows for harvesting the generated thermal energy by adding a fluid and conveying this fluid from the system to a desired location, such as a heat exchanger.



Images: Schematic view of the unit

The microfluidic approach provides the basis for a highly compact system that can easily be adjusted to an existing infrastructure and scaled to the respective requirements due to its modular design.

ADVANTAGES

- Fully reversible thermal energy storage
- Modular, adaptable and scalable system
- High cycle stability

REFERENCE:
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DEVELOPMENT STATUS:
Proof of concept

APPLICATIONS:
(Concentrated) Solar power-plants
Industrial excess heat

KEYWORDS:
Thermochemical energy storage
Microfluidics
Microreactor
Thermal energy recycling
Heat battery

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