Recycling as the key for developing sustainable hydrogen storage materials

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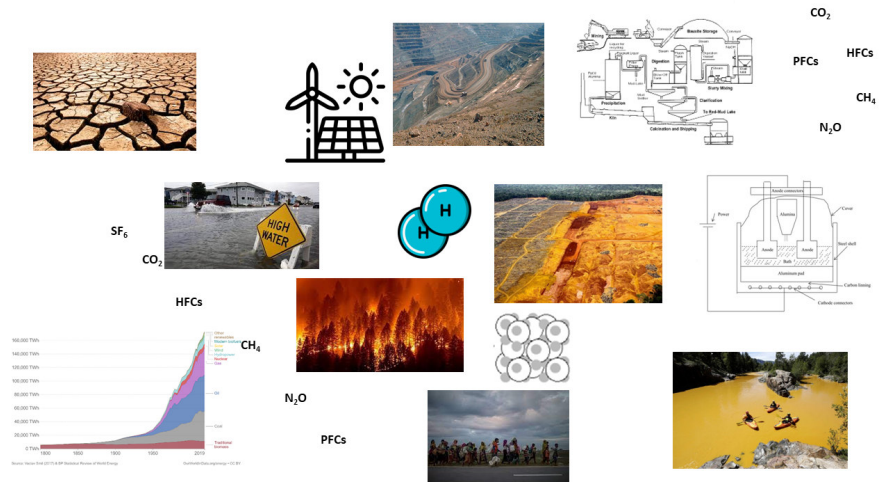
AIMS

High-purity metals are commonly used to produce hydrogen storage materials. The large-scale production of these materials is a heavy burden on the environment as they emit large amounts of greenhouse gases, not to mention the impact of the mining of the raw materials on the landscape itself.

In this work we aim at:

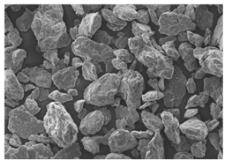
- Find alternative metal sources for the synthesis of high-quality solid-state hydrogen storage materials
- To test the obtained materials' hydrogen storage properties
- To check the influence of impurities on the material hydrogen storage properties



Magnesium Hydride

As-received AZ91 alloy

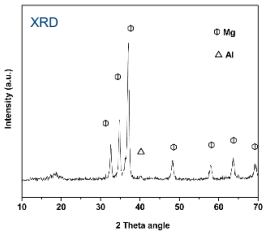
90 wt% Mg, 9 wt% Al, and 1 wt% Zn

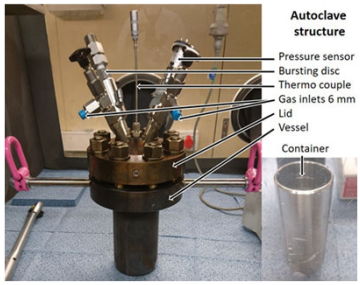


After milling

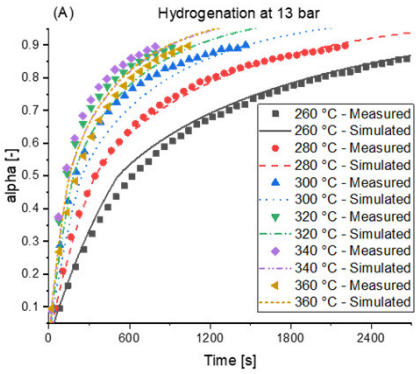
(CM08 ball-mill for 2h

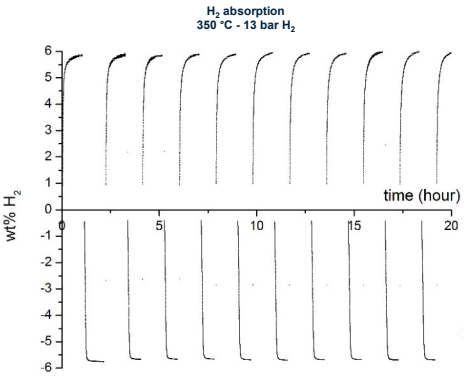
with the addition of 5 wt% of graphite)





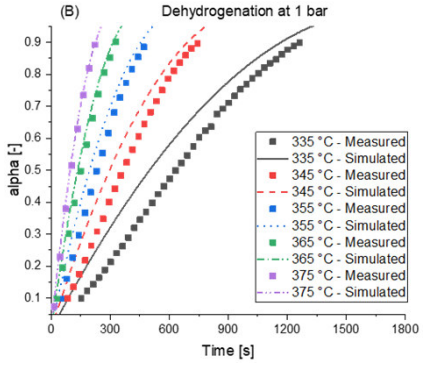
Picture of the autoclave with installed setup (left) and inlet which contains the powder (right).



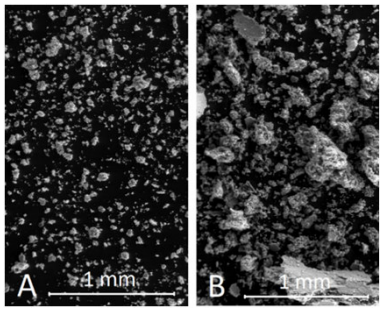


Reversible H_2 capacity 6 wt.-%!

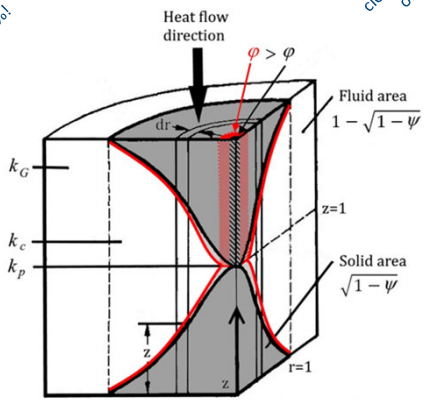
The developed models closely matched the results of the experiments.



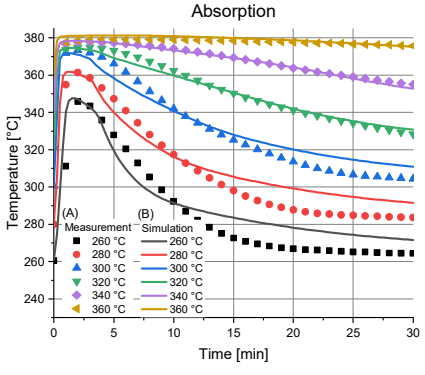
Measured and simulated hydrogen (A) absorption and (B) desorption reaction kinetic.



SEM pictures of cycled Mg-Al waste from A) loose top part and B) sintered fraction in the lower part of the autoclave.



Unit cell according to Zehner and Schlünder with increased particle contact area regarding the flattening coefficient, caused by the sintering.



Absorption measurements with the autoclave: Temperature development inside the powder bed for (A – dotted lines) the experiments and (B – solid lines) the simulations.

CONCLUSIONS

- Recycling industrial metal wastes is a sustainable path to synthesizing low-carbon footprint hydrogen storage materials.
- The validated simulation tool enables a better understanding of the larger scale for future system design and optimized engineering.

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