Reactive Metals for the Energy Transition

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Our society is facing a millennial challenge to slow down global warming below 2 °C in the long term.[1] Ambitious policy frameworks and policy intentions are a must to achieve this target. In fact, analyzing the status quo, International Energy Agency (IEA) concluded that the related carbon dioxide trajectories are not compatible with the climate targets, even if current policy commitments and pledges by governments are implemented.[2,3] The challenging issues are the limited use of renewables, merely considered for power generation, but only marginally addressing other carbon-intensive industrial sectors (e.g., cement, steel, smelting), and the practical reduction of CO_2 emissions from the transport sector.

Reactive metal-based storage systems are a new alternative to support the clean energy transition. Herein, the cases of Al and Na are presented, both preliminarily fulfilling the constraints regarding sustainability, but employing two rather different processes. Both, the steam combustion of molten Al for H_2 and heat production,[4,5] and a new rechargeable battery, which makes use of seawater and sodium as electrodes, show promising round-trip efficiencies.[6] The latter technology also allows CO_2-trapping, desalination, Na metal, and chlorine production. It is argued that further research efforts are needed to verify the sustainability and ability of reactive metal-based technologies to compete with other storage technologies.

References

[1] Report of the Conference of the Parties on its Twenty-First Session, held in Paris from 30 November to 13 December 2015, FCCC/CP/2015/10/ Add.1, United Nations Framework on Climate Change, United Nations, New York 2016.

[2] International Energy Agency, World Energy Outlook 2016, International Energy Agency, Paris 2016.

[3] International Energy Agency, World Energy Outlook 2019, International Energy Agency, Paris 2019.

[4] H. Ersoy, M. Baumann, L. Barelli, A. Ottaviano, L. Trombetti, M. Weil, S. Passerini, Adv. Mater. Technol. 2022, 2101400.

[5] L. Barelli, M. Baumann, G. Bidini, P. A. Ottaviano, R. V. Schneider, S. Passerini, L. Trombetti, Energy Technol. 2020, 8, 2000233.

[6] Y. Kim, M. Kuenzel, D. Steinle, X. Dong, G.-T. Kim, A. Varzi, S. Passerini, Energy Environ. Sci., 2022, 15, 2610.