Polyolefin-based membranes for hydrogen storage applications

Prokopios Georgopanos,[a] Hujun Cao,[b] Sergey Shishatskiy,[a] Fynn Weigelt,[a] Claudio Pistidda,[b] Giovanni Capurso,[b] Volkan Filiz,[a] Martin Dornheim,[b] Thomas Klassen,[b,c] Volker Abetz,[a, d]

[a] Institute of Polymer Research, Helmholtz-Zentrum Geesthacht GmbH, Max-Planck-Straße 1, 21502, Geesthacht, Germany.
[b] Institute of Materials Research, Materials Technology, Helmholtz-Zentrum Geesthacht GmbH, Max-Planck-Straße 1, 21502, Geesthacht, Germany.
[c] Institute of Materials Technology, Helmut Schmidt University, Holstenhofweg 85, 22043 Hamburg, Germany.
[d] Institute of Physical Chemistry, University of Hamburg, Martin-Luther-King-Platz 6, 20146 Hamburg, Germany.

E-Mail: prokopios.georgopanos@hzg.de, Fax: + 49 4152 87-2466, Tel: +49 4152 87-2420

Abstract

Polyolefines are known since decades and have been applied for industrial scale membrane gas separation, exhibiting good selectivities α for specific pair of gases, *e.g.*, $\alpha(O_2/N_2) \approx 4$. On the other hand, light metal hydride composites are promising materials for hydrogen storage applications, with drawbacks of coarsening microstructures and long-range phase separation upon cycling as well as oxidation upon exposure to ambient air, which leads to a reduction of hydrogen storage performance. In this work, the gas transport properties of the polymethylpentene TPX™, an olefin-based polymer, are presented and also the hydrogen storage properties of TPX™ embedded with $Mg(NH_2)_2$-LiH (Figure 1) metal hydride are described. The fabricated hybrid flat sheet material exhibits a significant improvement of the metal hydride stability in ambient air because the polyolefin protects the metal hydride from oxidation/degradation by hindering the diffusion of oxygen and water to the embedded metal hydride particles. In comparison to the pure metal hydride, the hybrid material retains the same hydrogen loading capacities and kinetic properties as pure metal hydride. Moreover, morphological analysis confirms that the metal hydride particles remain stable in the polymeric matrix and the three-dimensional integrity is retained, even after 20 de/re-hydrogenation cycles. This verifies that the polymer is not only protecting the metal hydride particles from the air but also maintains close vicinity of the reacting phases by confinement. The present study shows a promising way to fabricate metal hydride-polymer composite hydrogen storage materials that can be handled at ambient conditions *via* the implementation of TPX™ polymer.

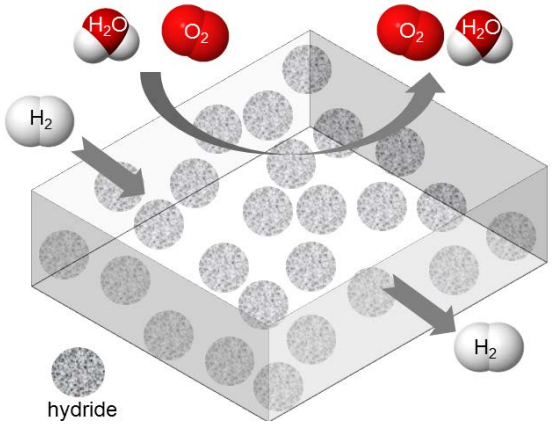


Figure 1. Schematic of metal hydride-TPX™ membranes for hydrogen storage applications.

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