Metal-polymer composites for hydrogen separation

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Abstract:

Development of new high-efficiency techniques for hydrogen separation and purification is one of the key areas in hydrogen energy. Membrane gas separation technology is of particular attractiveness for this purpose because of its simplicity and efficiency, easy combination with other methods. Conventional palladium-based membranes, in spite of record high selectivity to hydrogen, have a number of serious shortcomings. Meanwhile, there exists a wide range of more affordable hydride-forming intermetallic compounds, which are not inferior to palladium in the hydrogen affinity. Their adaptation for use in membrane process is an actual task. Here, we report the results of the research on metal-polymer composites specially designed for gas separation processes within the general concept of mixed matrix membranes (MMM).

Application of various polymers, namely polytetrafluoroethylene, polyethylene, polysulfone, polyetherimides through different synthesis techniques were employed to adjust AB- and AB5- type metal hydrides to production of gas separation film membranes. As it was shown, traditional methods of polymer membrane formation from the polymer solution with subsequent phase inversion is unsuitable for this type of materials since it does not provide defect free interface between metallic particles and polymer matrix. In contrast, ball milling pre-treatment ensures an optimal component conjunction. The composites produced in such a way retained their reactivity with respect to hydrogen, prevent the pulverization of the metal hydride and demonstrate the resistance to surface poisoning [1-2]. The best results were obtained for LaNi5 - polyethylene (PE) system with 10% of the filler [3]. Detailed study of gas transport properties proved that the membrane selectivity increased 50-150 times for H2/CH4 and H2/CO2 pairs compared to individual PE. It was concluded that the incorporation of a hydride-forming intermetallic compound to a polymer matrix is a promising approach to increasing the hydrogen separation performance of membrane materials

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Reference:

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