Lototskyy, M. et al. (2013). Application of surface-modified metal hydrides for hydrogen separation from gas mixtures containing carbon dioxide and monoxide.
Journal of Alloys and Compounds, 580: S382 –S385
http://dx.doi.org/10.1016/j.jallcom.2013.02.096

Application of surface-modified metal hydrides for hydrogen separation from gas mixtures containing carbon dioxide and monoxide

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Abstract
Application of surface-modified MH material for H_2 separation using temperature/pressure swing absorption–desorption was studied. The substrate alloy had the following composition $LaNi_{3.55}Co_{0.75}Al_{0.4}$-$Mn_{0.3}$, and the surface modification was carried out through fluorination followed by aminosilane functionalization and electroless deposition of Pd. The material was found to have good poisoning tolerance towards surface adsorbates, even for the large (rv1.5 kg) batches. Feasibility of its application for H_2 separation from gas mixtures (up to 30% CO_2 and 100 ppm CO) was demonstrated by testing of a prototype H_2 separation system (rv280 g of MH in two reactors), and H_2 separation reactor (0.75 kg of MH). The H_2 separation was characterized by stable performances in the duration of 250 absorption/desorption cycles. However, the total process productivity was found to be limited by the sluggish H_2 absorption (partial H_2 pressure 62.5 bar, temperature below 100 °C). In the presence of CO_2 and CO, additional deceleration of H_2 absorption was observed at space velocities of the feed gas below 5000 h

1. Introduction
Selectivity of reversible hydrogen interaction with hydride-forming materials allows for the development of simple and efficient pressure/temperature swing absorption–desorption systems for hydrogen separation from complex gas mixtures and its fine purification [1,2]. However, so far, this approach was successfully implemented only for hydrogen-rich feed gases (vent streams in the ammonia synthesis loop, H_2 > 50%) which contain relatively innocuous admixtures, mainly nitrogen and argon [3,4]. At the same time, the gases associated with processing of coal, petrol, natural gas and other carbonaceous/fossil fuels feedstock, in addition to hydrogen, may contain significant amounts of other components, mainly carbon dioxide and monoxide, which in most cases cause the deterioration of hydrogen sorption performances of metal hydrides (MHs) [5,6].

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