PALLAMONIA: HIGH PURITY HYDROGEN RECOVERY FROM AMMONIA WITH PALLADIUM MEMBRANE TECHNOLOGY

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ABSTRACT

Ammonia (NH_3) has emerged as a promising hydrogen carrier particularly with regards to fuel for hydrogen fuel cells. This is attributed to the high hydrogen content, relatively easy liquefaction and storage and transportation [1]. Compact and scalable technology for the efficient recovery of the hydrogen stored in ammonia is a prerequisite for enabling an increased use of ammonia as feedstock. Palladium (Pd) based membranes have the possibility for 100% selectivity towards hydrogen and Pd-based membrane technology is therefore highly suitable for achieving hydrogen with ultrahigh purity through separation [2].

The aim of the ongoing PALLAMONIA project is to enable the use of patented Pd-based membrane separators to enhance the recovery of high purity hydrogen from ammonia. This comprises both the use of a Pd-based membrane separator downstream an ammonia cracker and cracking and separation within the same unit.

The project has in part focused on elucidating the effect of ammonia on $Pd_{77}Ag_{23}$ membranes through theoretical calculations with DFT [3] and experimentally through hydrogen flux measurements of membranes in microchannel modules. The method of the latter was the same as in previous work by Peters et al. [4], but at higher levels of NH_3. In addition, the effect on the hydrogen flux of NH_3 concentrations at post-cracker levels (0-30 %) on composite $Pd_{77}Ag_{23}$ membranes mounted in a Hydrogen Mem-Tech separator has been investigated. The measurements were performed in the dedicated NH_3 lab of SINTEF Industry in Oslo, Norway.

Preliminary results show that there is a limited and reversible flux inhibition as a result of NH_3 exposure. This inhibition is dependent upon temperature and pressure, i.e. increasing the temperature and operating pressure reduces the inhibition. A set of conditions were determined which resulted in no decrease in flux for post-cracker levels of NH_3.

The preliminary results of the PALLAMONIA project are a strong indication that Pd-based membrane separation technology is a promising candidate for recovery of ultrahigh pure hydrogen from NH_3.

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