Performance Assessment of an Integrated PEFC and a Hydrogen Storage Device Based on Innovative Material

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ABSTRACT

Storage of hydrogen in solid materials has the potential to become a safe and efficient way to store energy, both for stationary and mobile applications. An integrated small scale system, integrating a small hydrogen tank and a 25 cm^2 PEFC single cell, has been tested to assess the performance of an innovative hydrogen storage material based on manganese oxide anchored to a polymeric matrix. A prototype small hydrogen tank, with a capacity of 18 cm^3 made of a stainless steel tube, has been filled with the hydrogen storage material, previously characterized and reaching an hydrogen storage capacity of about 1 wt%. The system included a temperature and pressure sensors and a mass flow to control the desorption rate. A Labview software application has been developed for data logging and control of the test set-up. Sorption process has been achieved by fixing the charging time and recording pressure vs time. The electrochemical tests were performed at 80°C (PEFC cell temperature) and several discharge-charge cycles have been performed at different pressure and two discharge rates (i.e. 100 and 200 ml/min). The nominal power produced by the PEFC cell has been between 6-10 W, with an average discharge time of 400-500 s, depending on charging time and pressure. This material, which adsorbs H_2 in no drastic condition and safe as inert when in contact with ambient air, has demonstrated both a good cycle reversibility in terms of H_2 charge and discharge and, moreover, not affected by the packing in the tank.

Keywords: Hydrogen storage material; H_2 tank and Fuel Cell integration; electrochemical tests.