Development and validation of traceable methods for the measurement of hydrogen absorbed in metal hydride tanks

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Abstract

Hydrogen is the most efficient energy carrier with the highest energy content per unit mass compared to any known fuels. Furthermore, hydrogen is the cleanest fuel and contributes significantly to the reduction of greenhouse gases since the only by-product during hydrogen consumption or combustion is water. The high energy density value per mass and the clean consumption (FCEV) and combustion (HICEV), free from pollutants that threaten the climate, makes hydrogen as fuel source very attractive for the automobile industry. In this context cost-effective storage of hydrogen in reliable tank systems is a key element for the utilization of hydrogen as alternative fuel. At the present time the three most popular procedures for storing hydrogen for transportation purposes are compressed hydrogen, liquid hydrogen and storage in metal hydrides. Due to the high volumetric storage capacity, reversible metal hydrides are one of the most interesting ways to store hydrogen. For the automobile industry and from the practical point of view, especially low temperature metal hydrides are of interest. In the best case these materials have a high gravimetric capacity, are kinetically fast and tolerate several hundreds of recharge cycles (life-cycles). The reversible storage capacity is a material property and it is from the technological side more important than the total or maximum storage capacity. The long-term cycling stability of a metal hydride is defined as ability to keep the reversible storage capacity during repeated hydrogen charge and discharge cycles. The cycling stability of the metal hydride is expressed as capacity loss over a given number of cycles. The current situation is that the different methods, available for the estimation of the absorbed quantity of hydrogen, do not provide accurate results in view of the test method proposed in ISO 16111 "Transportable gas storage devices - Hydrogen absorbed in reversible metal hydride". In this paper, different approaches for traceable measurements of hydrogen mass absorbed in reversible hydrides storage tanks of the types AB, AB2 and AB5 are described, evaluated and compared to each other. The article ends with recommendations on the most promising methods.

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