Nano Research & Applications
ISSN 2471-9838
2020
Vol.6 No.3

Estimation of Hydrogen Production Rate by Corrosion of Aluminum Alloys in Aqueous Solutions

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Abstract

The research of alternative processes to obtain clean fuels has become a main issue because of the concerns related to the current energy system, both from economical and environmental points of view. Hydrogen, a regenerative and environmentally friendly fuel with high calorific value, has attracted much attention by scientists. Although hydrogen is an attractive fuel alternative for the future, attractive methods for hydrogen production and storage must be employed to maintain its positive profile.

Therefore, to development of new technologies to generation hydrogen not base on fossil fuels is becoming more important to provide a clean fuel over the 21st century. Recently, generation of hydrogen for fuel cells by reaction of corrosion of metals with water or aqueous solutions reduces storage weight and/or volume over high pressure or cryogenic storage. Among all of them, Al is probably the most adequate metal for energetic purposes due to its high electron density and oxidation potential.

This study reports the estimation of H2 production rate by corrosion of aluminum alloys (Al-2024, Al-6061 and Al-7075) in aqueous solutions (HCl and NaOH) under different conditions using weight loss, hydrogen evolution, potentiodynamic polarization measurements and complemented by optical photography. The results showed a strong dependence of the H2 production rate on the solutions concentration, temperature, and type of the Al samples. In all conditions, the rate of H2 production and in turn the dissolution of aluminum alloys increases with increasing solution concentration and temperature.

Potentiodynamic polarization measurements appeared that the corrosion of Al alloys in HCl and NaOH concentrations is under cathodic control. The results of morphology investigation of Al alloys surfaces examined by optical photography before and after treatment in different concentrations of HCl and NaOH shows that Al samples seem to be rough due to formation of pits and intergranular corrosion. This may be due to the presence of some impurities which acts as cathodic to aluminum matrix and enhance the hydrogen reduction. Thus, there will be a galvanic action which leads to the formation of cavities on the metal surface. The surface roughness may also be due to the rupture of the protective oxide film. The discontinuous protective film leads to the direct exposure of the metal surface to the corrosive environment and there will be a material loss.

Biography:

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Webinar on Materials Science & Engineering**;** September 28-29, 2020.