Hydrogen Generation by Means of Hydrolysis Using Activated Al-In-Bi-Sn Composites for Electrochemical Energy Applications

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doi: 10.20964/2017.09.22

Received: 12 April 2017 / Accepted: 30 June 2017 / Published: 13 August 2017

Effective activation compounds are developed to produce hydrogen via hydrolysis of ball-milled Al-In-Bi-Sn composites in tap water at room temperature. Al-In-Bi-Sn composites are successfully activated by 3 h of milling. These composites exhibit hydrogen yields > 85% between 2.5 min (fastest reaction time) and 14 min (slowest reaction time). The intermetallic phases responsible for Al activation, InSn_4 , InBi and In_3Sn , are selectively synthesized, identified and characterized. The reaction kinetics of each intermetallic phase are determined after ternary composite preparation, i.e., milling Al with In and Bi or Sn. Quaternary composites are also prepared to determine the formation kinetics of the intermetallic phases. These quaternary composites have high hydrogen yields (> 90%) and the reactions are complete within 170 s. The formation of intermetallic phases is responsible for the structural failure of Al, resulting in the size reduction of Al particles. The following are also investigated and quantified: the effects of water volume and reaction temperature on hydrolysis kinetics, and the activation energies of ternary Al composites.

Keywords: Activated aluminum; Hydrogen generation; Mechanochemical activation

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