The effect of composition design on the hydrolysis reaction of Al−Li−Sn alloy and water

Abstract

A new method of hydrogen generation from Al−Li−Sn alloy was studied in the present article. The hydrogen generation performance of the alloy could be regulated via composition design. The optimized Al−10 wt% Li−5 wt% Sn alloy yielded 1,329 ml g−1 hydrogen with 100% efficiency and controllable hydrogen generation rate within 30 min at 298 K. Using X-ray diffraction, scanning electron microscopy, and Brunauer-Emmet-Teller analysis, the improved hydrogen generation performance mostly came from the AlLi and Li13Sn5 phases distributed into Al matrix, which were helpful to decrease the particle size in the milling process. The phases acted as the initial reaction centers and stimulated Al hydrolysis in the hydrolysis process. There existed different hydrolysis processes, including chemical reaction of aluminum and water catalyzed by hydrolysis byproduct LiOH and electrochemical corrosion of Al and Li. The latter was based on the dual micro-galvanic cells between Al−Sn and Li−Sn from Al−Li13Sn5 microstructure. Al−Li−Sn alloys had a potential application in portable hydrogen sources due to its high hydrogen generation density, high hydrogen purity, etc. The experimental data laid a foundation for hydrogen generator design.