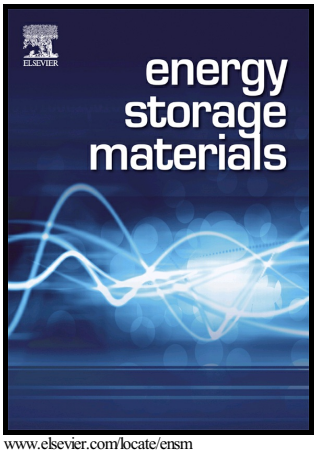

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Fundamental Study on the Wetting Property of Liquid Lithium

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Abstract

The wetting behavior of molten liquid lithium is important to many fields of applications, especially to the Li-matrix composite anodes for batteries. Although changing the wettability of matrices has been previously shown through surface-coating, the selection criteria for suitable coating materials and optimal coating thickness and the mechanism of wettability improvement still remain unclear. Here, we study the effects of temperature, surface chemistry and surface topography on the wettability of substrates by molten liquid lithium. We summarize the following guiding principles: 1) Higher temperature decreases the viscosity of molten liquid lithium and produces smaller contact angle. 2) The wettability can be improved by coating the substrates with Li-reactive materials. The negative Gibbs free energy drives the wetting thermodynamically. The solid reaction product (Li_2O) can cause kinetic barriers to wet. The contact angle decreases along with the increase of Li-reactive materials' coating thickness since more materials give more negative Gibbs free energy. Among all the coating materials, gold shows the best wettability due to the large negative Gibbs free energy released by the Li-Au reaction thus providing a strong driving force, and the lack of solid product (Li_2O) formation thus avoiding any spreading resistance of liquid lithium. 3) Substrate morphology also affects the wetting behavior of molten lithium, in way similar to water wetting. Surface roughness can increase drastically the lithiophobicity, resulting in super lithiophobic surface. These findings provide important insights in the design of Li-matrix composites and open up new opportunities for the practical application of lithium.

[1] These authors contributed equally to this paper.