

Surface Passivation and Reconditioning of Reactive Metals

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Reactive metals such as zinc, aluminum, and lithium are critical for corrosion inhibition and electrochemical energy storage, but their inherent instability presents major challenges for practical use. This talk highlights our recent works in surface passivation and reconstruction to stabilize and enhance these metals. For zinc foil and powders, chemical passivation creates a uniform, conformal, ultrathin oxyhydroxide layer that dramatically improves oxidation resistance and electrochemical cycling stability. For lithium, a rapid solution-based reconditioning treatment not only forms a favorable pre-SEI layer but also reconstructs the polycrystalline surface into a quasi-single-crystalline texture, enabling exceptional cycling performance. To investigate surface passivation and restructuring at the nanoscale, we synthesize single-crystalline nanostructures, such as nanowires and nanoplatelets of Zn and Al via solution chemistry. Preliminary results reveal how their surface passivation layers form in materials- and shape-dependent manners. Together, these findings demonstrate that surface engineering through controlled passivation and crystallographic reconstruction offers a versatile pathway to stabilize reactive metals, pointing to new fundamental insights and extended opportunities.