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Electrodeposited Lithiophilic Nanoparticles As Artificial Interphase for Anode-Free Lithium Ion Batteries

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The world is impatiently waiting for the lithium metal - to finally make a step forward from current battery technology. Safer and higher in energy and power density are the targeted improvements, and while the latter is met by the choice of lithium metal as anode (or more radically, no anode at all), the safety aspect is not as easily reached. The anode interphase was identified long ago as the critical element to this endeavour. Initial attempts at understanding and developing the solid electrolyte interphase (SEI) formation and its mechanisms on graphite have been paralleled by using alternative electrolytes (polymer, ceramic) or additives as well as numerous kinds of protective coatings to improve performance, lifetime and safety of battery cells. Lithiophilic metal coatings could also do the job, and it has been shown that sputtered Au or Zn layers on Li metal could prevent dendritic growth in a cell. The concept of artificial SEI engineering can be expanded on by using lithiophilic nanoparticles as opposed to continuous coatings. Nanoparticle decorated current collectors or lithium metal anodes can be made by electrodeposition, where the experimental conditions allow for the tuning of particle number density, size and composition. A precise understanding of the intermetallic phases formed between lithium and a lithiophilic-metal nanoparticle should enable their optimised design for highest performance and durability.

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