LITHIUM METAL BATTERIES

Flattening the tips

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Metal plating and stripping take place during electrochemical cycling of rechargeable batteries with metal anodes. Metal plating onto electrode surfaces during charging is rarely uniform in conventional battery settings, leading to the formation of metal dendrites that not only degrade battery performance but also pose a safety hazard. Intensive research efforts are underway to tackle the dendrite issue, especially for batteries with metallic lithium anodes. Now, Nikhil Koratkar and colleagues at the Rensselaer Polytechnic Institute and the University of Maryland report that, unlike their lithium counterparts, potassium dendrites in potassium metal batteries can be flattened at current densities of 2 mA cm^{-2} , offering the advantage of safer operation.

The researchers conduct two cycling tests for a potassium metal cell, one at 0.5 mA cm^{-2} and another also at 0.5 mA cm^{-2} , but with current bursts of 2 mA cm^{-2} . While protruding dendrites are clearly present at low current density, they become flattened when the current is increased. The researchers use theoretical modelling to show that the diffusion of potassium atoms at potassium surfaces has a much lower energy barrier than lithium diffusion at lithium surfaces. Therefore, internal heat generated at the higher current helps potassium to overcome the diffusion barrier and move away from the dendrite tips, thereby smoothening dendrite surfaces. By contrast, lithium dendrites require an order of magnitude higher current density for surface smoothening and the much larger internal heat generated could be detrimental for other cell properties.

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