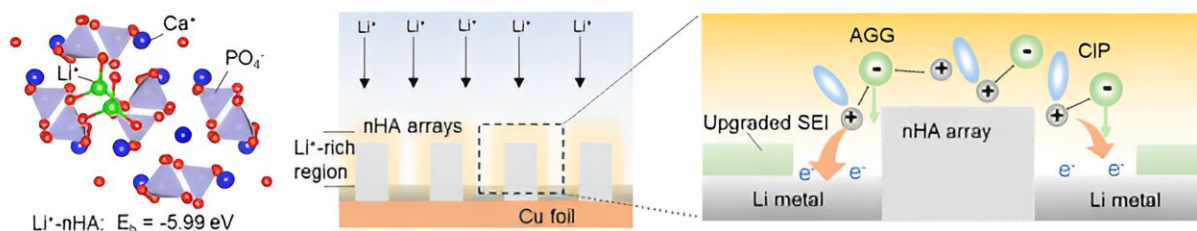


Scientists develop functional micro-arrays for efficient lithium metal anode interface

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Interaction of nano-hydroxyapatite with lithium ions and effect on the formation of solid electrolyte interface. Credit: IMR

Lithium (Li) metal anodes, with the highest specific capacity ($3,860 \text{ mAh g}^{-1}$) and the lowest redox potential (-3.04 V vs. standard hydrogen electrode), are considered a potential alternative for the next generation high-energy-density lithium batteries. However, the unstable electrolyte–Li metal anode interface has been the biggest obstacle for the practical application of Li metal anode batteries.

Researchers led by Prof. Bai Shuo and Prof. Li Feng from the Institute of Metal Research (IMR) of the Chinese Academy of Sciences (CAS), together with Prof. Tan Jun from Ji Hua Laboratory, have achieved the spatially selective distribution of the targeted solvation structure of ions at the [electrolyte–anode](#) interface by fabricating micro-arrays of nano-hydroxyapatite (nHA) with high Li^+ binding energy on copper (Cu) foil.

Their work was published in [Advanced Materials](#).

According to the researchers, the key to a stable Li metal anode is to construct a robust solid electrolyte interface (SEI) film at the electrolyte–anode interface. The most ideal approach is to optimize the solvated structure of the ions in the electrolyte, especially at the electrolyte–anode interface, while maintaining the properties of the bulk electrolyte.

They found that the electronegative nHA particles with high Li^+ binding energy can effectively tune the solvation structure of ions in the electrolyte. Li^+ will preferentially migrate to the surface of the nHA particle, forming a local Li^+ -rich region around the nHA particle, where anions can interact with more Li^+ to form multi-coordinated anions.

Based on this finding, micro-arrays of nHA are further prepared on Cu foil (current collector of the anode) to preferentially form multi-coordinated anions at the electrolyte–anode interface. Meanwhile, the experiment also verifies that the micro-arrays do not affect the solvation structure of the bulk electrolyte.

In general, uncoordinated anions are strongly repelled by the electron-rich anode, which greatly reduces the decomposition efficiency of the anions. In this study, using nHA micro-arrays, the multi-coordinated anions at the electrolyte–anode [interface](#) can be carried by Li^+ to effectively cross the electric double layer on the anode, which is desired for an anion-derived SEI film. The [anions](#) in the electrolyte are more completely decomposed into highly protective inorganic components in the SEI film, which can effectively suppress the dendrite growth on the anode.

As a result, at high charge-discharge current densities, the risk of the notorious micro-short circuit happening in Li-metal batteries is

significantly reduced.

The finding of electronegative materials tuning local solvation structure in the electrolyte provides new design principles for building robust SEI for stable Li-metal batteries.

More information: Haorui Shen et al, Spatially Selective Solvation Structure by Electronegative Micro-Arrays for Stable Lithium-Metal Anode Interface, *Advanced Materials* (2023). [DOI: 10.1002/adma.202306553](https://doi.org/10.1002/adma.202306553)

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