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Tailoring the surface states of dealloyed nanoporous metals for energy technologies

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Nanoporous metals can be conveniently mass-produced by selective dissolution of active component(s) from binary or multi-component alloys, a route traditionally known as dealloying. These dealloyed nanoporous metals possess superior electron conductivity (typically 3-5 orders of magnitude in enhancement of conductivity as compared to the traditional carbon-based electrodes) and monolithic nanostructures with tunable pore/ligament sizes from a few nanometers to micron scale. They can be readily surface-decorated with a wide variety of functional materials such as Pt-group metals (for PEMFCs), metal oxides or conducting polymers (for supercapacitors), or Sn/Ge metal nanoparticles (for LIBs) with tailored interfacial structures. Recent investigations also proved their great potential as unique cathodes for reversible and high rate Li-O_2 and Li-S batteries. These 3D metallic nanostructures are intrinsically active for these key electrode reactions, and their open nanoporosity can effectively accommodate possible volume variations during charging and discharging while providing fast transportation of active species and electrons. The interconnected framework also facilitates heat transfer and simplifies device implementation as they can simultaneously function as active electrodes and current collectors. This talk will summarize recent advances in this field associated with the unique interfacial structural properties of multifunctional nanoporous metals. In particular, we will discuss how to design catalytically active states to drive highly efficient organic molecule oxidation or decomposition which is crucial for next generation proton exchange membrane fuel cells.

Keywords: Nanoporous Metals; Dealloying; Fuel Cells; Electrocatalysis.