Dealloyed 3D Nanoporous Materials for Energy Conversion and Storage

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Abstract

Three-dimensional (3D) bulk nanoporous materials made by selective alloy corrosion are very promising for energy applications including electrochemical energy conversion and storage, (electro)catalysis, energy-efficient actuators and sensors, as well as gas storage and CO₂ capture. Despite its high popularity, chemical dealloying widely used for the fabrication of these 3D nanoporous materials is a relatively slow process; Dealloying a few milligrams of bulk materials may take from several hours up to a few days depending on the material system. Raising the temperature of the corroding medium is a common approach to speed up the dealloying process. However, high temperatures cause undesired ligaments growth in dealloyed materials. In the first part of this talk, I will demonstrate the use of catalysts to speed up the dealloying process at ambient temperature and pressure [1]. This new approach is expected to play a central role in scaling up the dealloying process. In the second part of my talk, I will discuss emerging energy related applications involving these 3D nanoporous materials [2, 3].

[1] Z. Deng & E. Detsi: Accepted for publication in Nanoscale  

Biography

Eric’s primary research interests involve the novel design and synthesis of metal-based 3D nanostructured materials with enhanced properties for structural and functional applications. His approach is to apply the natural sciences, primarily physics and chemistry, to solve engineering problems. In particular, Eric exploits the crystal structure of multiphase non-precious metal alloys to engineer nanoporous materials with hierarchical porosity after selective leaching. Hierarchical porous structures are attractive as alloy-type anode materials in alkali and alkaline-earth metals batteries, because the macropores (50-1000 nm) are needed for long range electrolyte diffusion through the material, while the mesopores (2-50 nm) and micropores (< 2 nm) are needed to create high-surface area and short diffusion paths for alkali or alkaline-earth metals. More importantly, micro and mesopores are needed to accommodate the large volume changes taking place in high-capacity alloy-type battery anodes during their alloying reactions with alkali or alkaline-earth metals. Eric also takes advantage of state-of-the-art thin film deposition techniques such as plasma-enhanced atomic layer deposition, combined with his expertise in top-down nanofabrication by selective leaching, to engineer novel 3D nanocomposites for critical energy applications.
Spring '18 Seminar Series
Department of Materials Science and Engineering

Refreshments served at 3:45 p.m. in Student Lounge – Whitaker 349
Attendance is required of all full-time MSE Graduate Students.
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