2D metal oxide nanostructures for sustainable energy technologies

Ziqi Sun
[1] *School of Chemistry and Physics, Queensland University of Technology, Australia*
Email: ziqi.sun@qut.edu.au

Sustainable energy has been regarded as one promising alternative to displace current fossil energy resources by its high energy value and zero CO_2 emission to address the increasing environment and energy crises. Especially, electrochemical energy systems are expected to be the most feasible approach with a good balance of cost and efficiency, in which nanostructured electrodes are the most critical component and govern the conversion cost and energy efficiency. Therefore, the search of affordable electrode materials and structures with comparable performance to replace with the current traditional energy technologies is an urgent priority. In this presentation, inspired by the salient properties of 2D materials, promising 2D metal oxide-based nanostructures for electrochemical energy devices through mechanism understandings and performance upgrades will be presented. It is expected that this presentation will provide some insights into designing low-cost but efficient electrodes for reaching affordable and reliable sustainable energy supplies.

Biography

Ziqi Sun is currently a full professor at Queensland University of Technology (QUT). He has received multiple ARC fellowships, including one just completed ARC Future Fellowship and one ongoing ARC Industry Mid-Career Fellowship. His research interest includes rational design of metal oxides for sustainable energy and environmental technologies, such as rechargeable batteries, green hydrogen production, and industry catalysis. Ziqi serves as the Editor-in-Chief of *Sustainable Materials and Technologies* (IF = 9.6) and Handling Editor of *Physics Open*. For his contribution to chemistry research and education, he has been elected as the Fellow of the Higher Education Academy and Fellow of the Royal Chemical Society.

Additive Manufacturing of Advanced Ceramics

Vincenzo Esposito

Department of Energy Conversion and Storage, Solid State Electrochemistry

e-mail vies@dtu.dk

Abstract: Additive manufacturing is transforming the landscape of advanced ceramics, offering unprecedented control over material architecture and functionality. In this presentation, we explore how three-dimensional (3D) printing, particularly high-resolution techniques such as digital light processing, enables the design of ceramic materials beyond traditional planar constraints. By leveraging architected geometries, it becomes possible to decouple density, mechanical strength, and transport properties, unlocking novel electrochemical and electromechanical performance. We discuss recent breakthroughs in functional ceramic metamaterials, including energy storage devices, electromechanical transducers, and ionically active scaffolds, where 3D structuring plays a central role in enhancing performance. Through experimental results, numerical simulation, and application-oriented case studies, the talk highlights how 3D printing is not just a fabrication tool but a platform for material innovation.

Vincenzo Esposito is a full Professor at the Department of Energy Conversion and Storage, Technical University of Denmark (DTU). His research focuses on the fundamental properties of metal oxides, with an emphasis on hybrid ionic–electronic and electromechanical phenomena. He leads projects on additive manufacturing and thin-film processing of functional ceramics for energy and information technologies. His group integrates advanced synthesis, in situ characterization, and modeling to design oxide materials with programmable properties and multifunctional performance.