LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

LLNL-JRNL-833770

POROUS CARBON AND CARBONACEOUS MATERIALS FOR ENERGY CONVERSION AND STORAGE

T. Liu, T. Li, M. A. Worsley, T. Zhai

April 11, 2022

Journal of Materials Research

LLNL-JRNL-833770

POROUS CARBON AND CARBONACEOUS MATERIALS FOR ENERGY CONVERSION AND STORAGE

This special issue of the Journal of Materials Research contains articles that were accepted in response to an invitation for manuscripts.

Introduction

Guest Editors:

Tianyu Liu
Virginia Polytechnic Institution and State University, VA, USA

Yat Li
University of California, Santa Cruz, CA, USA

Marcus A. Worsley
Lawrence Livermore National Laboratory, CA, USA

Teng Zhai
Nanjing University of Science and Technology, China

Growing awareness of increasing global population and energy demand, diminishing supplies of fossil fuels, proliferating environmental pollution, and climate change has driven rapid developments in materials research in energy conversion and storage. This area of study offers new solutions to these daunting challenges, from ensuring a steady energy stream produced by sustainable energy (e.g., solar, tidal and wind energy) to capturing and converting green-house gases to value-added products.

Carbon and carbonaceous materials play a central role in energy storage and conversion, due mainly to their structural diversity, natural abundance, high electrical conductivity, tunable physical and chemical properties, and economic viability. They have been widely adopted as active materials on their own (such as free-standing electrodes for supercapacitors and batteries) and as supporting scaffolds for functional particulates (e.g., carbon-metal oxide composite catalysts).

Creating pores in carbon and carbonaceous materials significantly improves their corresponding performance in different applications. With their enhanced surface area, facilitated ion diffusion kinetics, and in some cases, coupling with heteroatom dopants and other high-performance guest materials, these materials are explored extensively as candidates for next-generation energy conversion and storage devices. The recent emergence of diverse arrays of carbon-based materials with hierarchically porous structures, i.e., architectures with interconnected and multiscale pores (with pore width ranging from sub-

This work was perf ormed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

nanometers to hundreds of microns), have stimulated a plethora of in-depth experimental work along with fundamental studies elucidating the ion motion dynamics confined in pores.

The versatility of these materials in energy conversion and storage is well represented by the wide scope of topics published in this Focus Issue. Here you will find morphologically diverse structures including zero-dimensional nanoparticles, one-dimensional nanotubes, two-dimensional nanosheets, and three-dimensional networks, as well as applications of these developed materials including colloidal sol-gel chemistry, electrodes for supercapacitors, lithium-ion batteries, sodium-ion batteries, electrically conductive scaffolds decorated with catalysts for microbial fuel cells, oxygen reduction reactions, oxygen evolution reactions, and hydrogen evolution reactions. This forum for scientists with different backgrounds will provide insightful information for readers working or interested in relevant and interdisciplinary research fields.

Finally, we, the guest editors, would like to take this opportunity to acknowledge our authors for their high-quality and well-crafted manuscripts, our reviewers for their prompt and careful evaluations, and our readers for your kind support in reading this issue. We would not have accomplished this Focus Issue without all your endeavors, dedication, and time commitment.