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M.K. Shobana, Yunsung Kim

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Improved Electrode Materials for Li-ion batteries using Microscale and Sub-Micrometer Scale Porous Materials - A Review

M.K. Shobana[1*], Yunsung Kim[2]

[*1]Department of Physics, School of Advanced Science, VIT University, Vellore, Tamilnadu 632014, India
[2] Department of Mechanical Engineering, University of Michigan, Ann Arbor, MI, USA

Corresponding author: Email: mkshobana@gmail.com

Telephone number:**914162202321/22**

Fax: **914162243092**

Abstract

In this paper, we review the challenges and opportunities for foam materials and their composites as novel energy conversion materials. Specifically, foams with an exceptionally high specific surface area could be a perfect solution for advanced energy applications because the electrodes with limited reaction area between an electrolyte and an active material have been identified as one of the key factors affecting the low-level performance of Li-ion batteries, which is a major challenge hindering their commercial application. In the past decade, several electrode materials, structures, and fabrication processes have been developed and investigated with the intention of improving electrode performance. Among these processes, foam architecture is attractive as an electrode structure in Li-ion batteries as it has an intrinsic structural integrity with the ability to buffer stress caused by the large volume changes in high capacity anode materials during cycling. In this review, the electrochemical properties, reversible capacity, long cycle capability, high discharge capacity, battery lifetime, power density, energy efficiency, tensile strength, and mechanical properties of various foam electrode materials are discussed. The foremost objective of this review is to provide an overview on the latest research on improved electrode performance and current perspectives on porous electrode materials for future Li-ion batteries.

Key words: electrode material, energy storage material, sol-gel process, mechanical property