Vinodkumar Etacheri, J Fundam Renewable Energy Appl 2018, Volume 8
DOI: 10.4172/2090-4541-C5-062

Defect and interface induced Li/Na-ion storage in nano-engineered electrodes

Vinodkumar Etacheri
IMDEA Materials Institute, Spain

Development of rechargeable batteries with high performance and safety is one of the key challenges faced by modern electrochemistry. Rechargeable Li-ion batteries attracted significant attention during the last two decades due to their widespread application in portable electronics, medical implants, grid-level energy storage and electric vehicles. Recently, secondary Na-ion batteries emerged as an alternative candidate for large scale energy storage. Low-cost and abundance of resources are main advantages of this technology. Li-O_2 batteries are another high-performance battery system, which has several fold energy densities compared to the conventional Li-ion batteries. Despite of the several advantages of Li and Na-ion based batteries, their energy and power densities are not sufficient for more energy demanding commercial applications such as long-range driving. Consequently, development of high-performance electrode materials is necessary to improve the energy and power density of these secondary battery systems. Nanostructured transition metal oxide based electrodes are fabricated to mitigate the drawbacks of electrodes used in conventional Li and Na-ion batteries. Main focus of this work is the interface and defect engineering to boost pseudocapacitive type Li/Na ion storage. Solution based bottom-up synthetic approach and carbothermal reduction method are used for the synthesis of defect and interface engineered electrode materials. Lithium and sodium ion batteries containing defect engineered 1D, 2D and 3D electrodes demonstrated specific capacities up to 1300 mAh/g and high rate performance up to 30 A/g current density. Spectroscopic, microscopic and electrochemical studies proved conventional conversion reaction and pseudocapacitive Li/Na ion storage. High specific capacity (5000 mAh/g) and stable cycling are observed in the case of Li-O_2 batteries. Enhanced electrochemical performances are attributed to the synergy between pseudocapacitive and conversion-type charge storage mechanism.

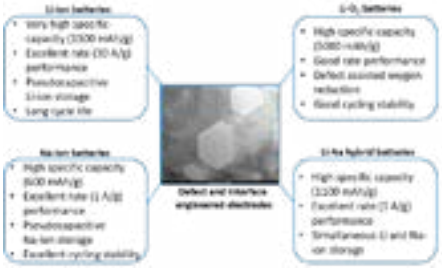

Figure 1: Schematic of the application of defect and interface engineered electrodes in Li-ion, Na-ion, Li-O_2 and Li-Na hybrid batteries.

Recent Publications

1. Etacheri V, Hong C N, Tang J and Pol V G (2018) Cobalt nanoparticles chemically bonded to carbon nanosheets: A stable anode for fast-charging Li-ion batteries. ACS Applied Mater Interfaces 10:4652-4661.
2. Hong S M, Etacheri V, Hong C N, Choi S W, Lee K B and Pol V G (2017) Enhanced lithium and sodium ion storage in an interconnected carbon network comprising electronegative fluorine ACS Applied Mater Interfaces 9:18790-18798.
3. Henzie J, Etacheri V, Jahan M, Hong C N, Rong H and Pol V G (2017) Biomineralization inspired crystallization of monodisperse Mn2O3 octahedra and assembly of high-capacity lithium-ion battery anodes. Journal of Materials Chemistry A 5:6079-6089.
4. Etacheri V, Seisenbaeva G A, Caruthers J, Daniel G, Nedelec J M, Kessler V G and Pol V G (2015) Ordered network of interconnected SnO2 nanoparticles for excellent lithium-ion storage. Advanced Energy Materials 5:1401289.
5. Etacheri V, Yourey J E and Bartlett B M (2014) Chemically bonded TiO2 bronze nanosheet/ reduced graphene oxide hybrid for high-power lithium-ion batteries. ACS Nano 8:1491-1499.

Biography

Vinodkumar Etacheri is a Scientist and Electrochemistry Group Leader at IMDEA Materials Institute, Madrid, Spain. He obtained his PhD in Materials Chemistry from Dublin Institute of Technology (DIT), Ireland in 2011. He then completed Postdoctoral research at Bar Ilan University-Israel, University of Michigan, USA and Purdue University, USA in the area of Li-ion, Li-O_2, Li-S, and Na-ion batteries. His research areas extend from solar energy conversion to electrochemical energy storage materials and devices. He has co-authored more than 30 papers (>4500 citations) in international peer reviewed journals, three book chapters, and eight patents.

vinodkumaretacheri@imdea.org

Notes: