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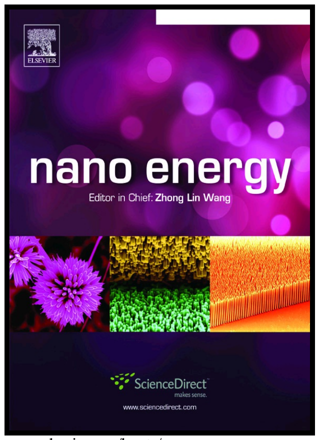

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Danni Lei [a], Dong-Chan Lee [a], Enbo Zhao [a,b], Alexandre Magasinski [a], Hong-Ryun Jung [a], Gene Berdichevsky [c], Daniel Steingart [d] and Gleb Yushin [a]*

[a] School of Materials Science and Engineering, Georgia Institute of Technology, Atlanta, GA 30332, USA.

[b] School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA 30332, USA.

[c] Sila Nanotechnologies, Inc., Alameda, CA 95401, USA

[d] Department of Mechanical and Aerospace Engineering, Andlinger Center for Energy and the Environment, Princeton University, Princeton, NJ 08544, USA

*E-mail: yushin@gatech.edu

Abstract

Rechargeable aqueous batteries are attracting renewed attention due to flammability and high cost of lithium-ion cells. Extremely low cost, very high abundance and eco-friendliness of iron (Fe) anodes make them particularly attractive for aqueous chemistries. Unfortunately, traditional Fe anodes suffer from low capacity utilization, the need for formation pre-cycling and dissolution of active material when fully discharged. Known methods for synthesis of nanocomposite Fe anode are expensive and offer poor control over material properties and uniformity. We report on a novel low-cost synthesis route to produce nanocomposites with crystalline FeO_x nanoparticles very uniformly distributed within individual nanoporous carbon particles. The conductivity enhancement and a very small size of FeO_x particles (< 5 nm) effectively enhance the discharge capacity of Fe anodes up to 600 mAh g^{-1}. In contrast to graphene-FeO_x or carbon nanotube-FeO_x, the large size of the produced nanocomposite particles allows them to be processed into electrodes the same way as supercapacitor electrodes are mass-produced by industry. The nanoconfinement suppresses side reactions, such as nanoFe dissolution and hydrogen evolution, resulting in capacity retention of up to ~85 % after 200 cycles. When used in combination with novel In-based additives, reported anodes uniquely exhibited a single high-voltage discharge profile in full cells, which improves energy density of cells and simplifies battery management system.