

New Perspectives on Electrochemical Energy Storage Materials

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Energy storage in the electrochemical form is attractive because of its high efficiency and fast response time. New and improved materials for energy storage are urgently required to make more efficient use of our finite supply of fossil fuels, and to enable the effective use of renewable energy sources. I will discuss a few new perspectives for energy storage materials including new Li intercalation compounds [1], new Na intercalation compounds [2] and new flow battery chemistry [3]. I will demonstrate how to combine knowledge-guided synthesis/characterization and first principles computation to develop and optimize new higher energy/power density electrode materials for rechargeable batteries. With new spectroscopic and microscopic tools we are able to explore intrinsic ionic mobility and phase transformations in electrode materials, and develop an approach to map out the structure-properties relations in functional oxide materials for energy storage and conversion.

References

[1]. J. Shin, S. Cohen and Y.S. Meng, "MIL-101(Fe) as secondary battery electrode materials". Submitted, 2013

[2]. D.H. Lee, Jing Xu and Y.S. Meng, "New high energy density sodium intercalation compounds". Submitted, 2013.

[3]. M. G. Verde, K. J. Carroll, Z. Wang, A. Sathrum and Y.S. Meng, "Achieving high efficiency and cyclability in inexpensive soluble lead flow batteries". Energy and Environmental Science, DOI: 10.1039/c3ee40631h. 2013

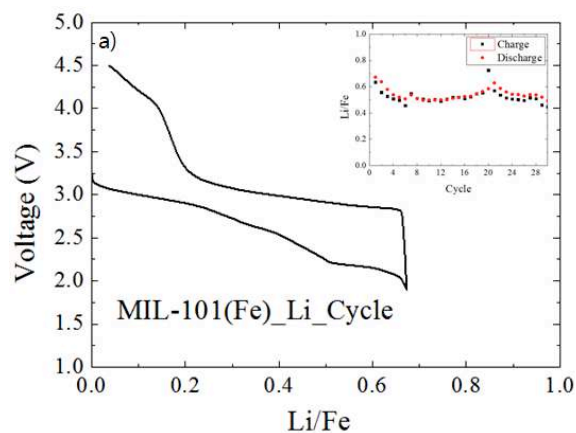


Figure 1. Electrochemical properties of new lithium intercalation MOF compounds. From Ref. 1

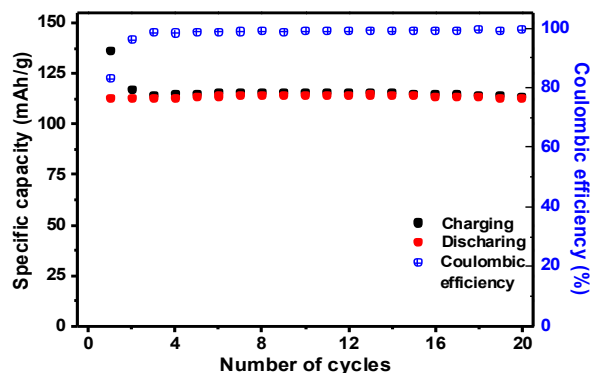


Figure 2. Electrochemical efficiencies of sodium intercalation compounds. From Ref. 2

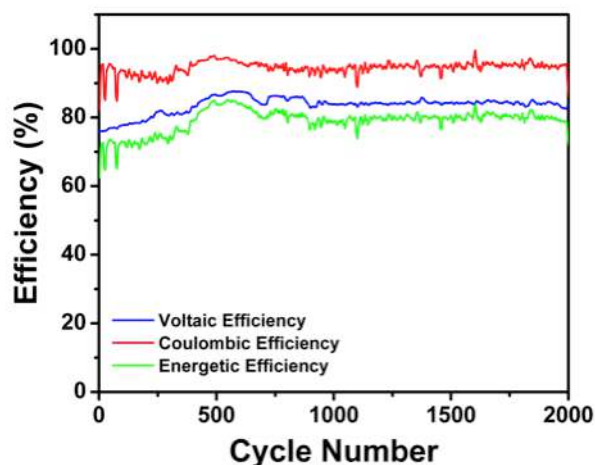


Figure 3. Electrochemical efficiencies of optimized Soluble Lead Flow Batteries SLFB. From Ref. 3