SEMINARIO

Batteries, displays, and non-volatile synaptic transistors: optimizing structure for enhanced performance of solid state electrochemical devices

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Rechargeable batteries with high energy density, high power, inherent safety, long cycle life, and compatibility with microchip packaging are increasingly needed to power wearable and implantable electronics as well as a range of autonomous microsystems with applications in medicine, environmental monitoring and the 'internet of things' technologies. Although thin film solid state Li-ion batteries are process-compatible with most microelectronics fabrication schemes and are now commercially available, their low areal energy density limits both the extent of miniaturization and the performance characteristics of autonomous microsystems. The simple solution of increasing the thickness of the battery electrodes to store more energy reduces the power capability, because ions must diffuse longer distances. As an alternative to simple thickness scaling, various three dimensional (3D) solid state Li ion battery designs have been proposed that use height (vertical topography) to increase the electrode surface area per geometric footprint. While simple conceptually, realizing working 3D solid state Li ion batteries has proven to be a significant challenge. In the first part of my talk I will discuss our recent work on fabrication, characterization and modeling of 3D solid state Li-ion batteries using semiconductor compatible fabrication schemes, with emphasis on how the microstructure, the Li transport characteristics, and the electrode/electrolyte interfaces affect the battery performance [1]. Next, I will discuss electrochromic displays, which, like batteries work by cycling ions and electrons between electrodes separated by an electrolyte and where high speed is essential for displaying video [2]. Finally, I will describe a Li-ion synaptic transistor for analog computing (LISTA) which is ideally suited as an artificial synapse in neuromorphic networks with switching voltage as low as 5 mV, high density of non-volatile analog states, and record performance in execution of neural algorithms [3].

Bio: Alec Talin is a Distinguished Member of Technical Staff at Sandia National Laboratories, in Livermore, CA and a Principal Founding Editor of MRS Communications. Prior to joining Sandia in 2002, Alec spent six years as a research scientist and manager at the Motorola Corporate Labs in Phoenix, AZ, and was a Project Leader at the Center for Nanoscale Science and Technology at NIST from 2009 to 2012. Currently, Alec leads a number of projects at Sandia in novel electronic materials and devices, energy storage and conversion, and national security.

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