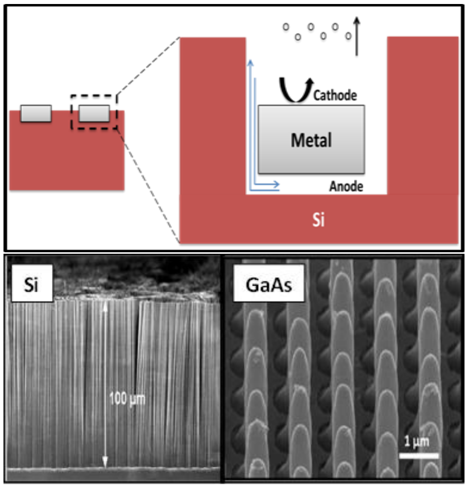
NANOHOUR

Wednesday, September 19, 2012 3:00 pm
Beckman Institute - Room 2269

MacEtch for High Aspect Ratio Semiconductor Micro/nanofabrication

Karthik Balasundaram, Electrical and Computer Engineering
Graduate Student with Professor Xiuling Li



In semiconductor device fabrication and process integration, etching is one of the important steps used for the definition and isolation of discrete device structures. One of the recently developed wet etching methods of silicon is Metal-assisted Chemical Etching (MacEtch) which is simple, low cost, anisotropic and capable of producing micro/nanostructures of High Aspect Ratios (HAR) from a patterned metal film. In this talk, I will discuss the mechanism, process chemistry and unique characteristics of MacEtch and some of the current challenges in fabricating silicon micro/nanopillars of high aspect ratios. I will also briefly describe our recent results on extending this technique to non-silicon based materials and their potential applications.

High Power Lithium Ion Microbatteries

James Pikul, Mechanical Science and Engineering
Graduate Student with Professor William King

We report lithium ion microbatteries having power densities up to 7.4 mW/cm^{2}µm, which equals or exceeds that of the best supercapacitors, and which is 2000 times higher than that of other microbatteries. The high power density is enabled by three-dimensional (3D) bicontinuous interdigitated microelectrodes that concurrently optimize ion and electron transport for high power delivery while maintaining good energy density.

Miniature power sources for MEMS and microelectronics have been limited by their energy and power performance. Previous research on microbatteries has focused on achieving high areal energy density rather than volumetric energy or power density, leading to 3D microbatteries with energy and power densities between 0.01-7 µWh/cm^{2}µm and 0.04-3.5 µW/cm^{2}µm. It has proven difficult for batteries to achieve the high power of supercapacitors, which can be fabricated at nearly any size and have power densities larger than 4.0 mW/cm^{2}µm, but have 10X less energy density than conventional batteries. This work presents microbatteries with 3D bicontinuous interdigitated microelectrodes that achieve power densities up to 7.4 mW/cm^{2}µm and energy densities up to 15 µWh/cm^{2}µm. Table 1 compares the volumetric energy and average power density of our microbattery cells to 3D microbattery cells from the literature. At a low discharge rate our battery has 2X the energy density and 6X the power density of the best previous cells. At a high discharge rate our battery has larger energy density than 3 of the 4 previous cells and 2,000X the power density of the best previous cell.

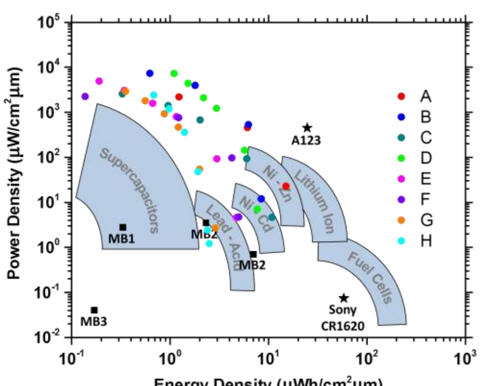


Figure 1. Ragone plot showing the performance of our microbattery cells (A through H), along with previous microbattery cells having 3D electrodes (MB1 through MB3). The plot also shows the performance range of conventional power sources and commercial batteries from A123 (high power) and Sony (high energy).

Coffee and cookies will be served
http://nanohour.beckman.illinois.edu