Electronic Supplementary Material (ESI) for Nanoscale.
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[Supporting Information (SI) to accompany:]

High performance asymmetric V_2O_5-SnO_2 nanopore battery by atomic layer deposition

Chanyuan Liu*[1], Nam Kim[2], Gary W. Rubloff [3, 4], Sang Bok Lee*[2]

[1]Lam Research Corp, Tualatin, OR 97062, USA.

[2]Department of Chemistry and Biochemistry, University of Maryland, College Park, Maryland 20742, USA

[3]Department of Materials Science and Engineering, University of Maryland, College Park, Maryland 20742, USA

[4]Institute for Systems Research, University of Maryland, College Park, Maryland 20742, USA

Corresponding Authors:

Chanyuan Liu: chanyuan.liu@lamresearch.com

Sang Bok Lee: slee@umd.edu

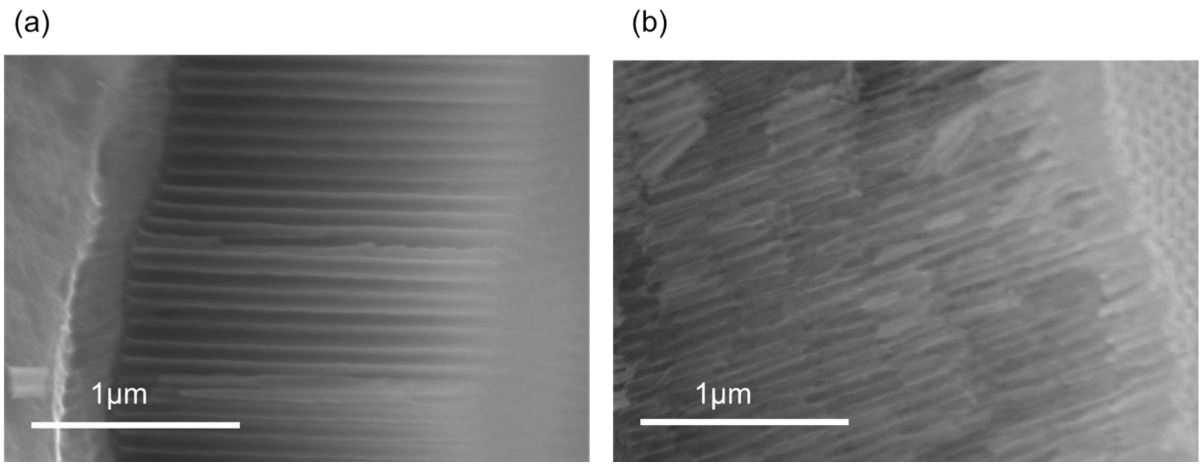

Figure S1. (a) Straight AAO and (b) interconnecting AAO.

SnO_2 is deposited by a thermal process using Tetrakis(dimethylamino)tin(IV) (TDMA-Sn) and water at 150C with growth rate of 0.7A/cycle on silicon, which is confirmed by TEM cross section and in agreement with previous literature.

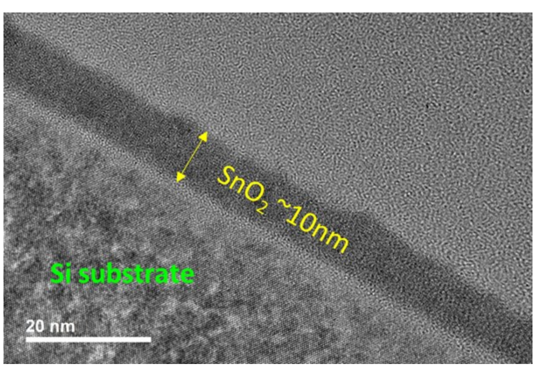

Figure S2. SnO_2 ALD process development. TEM cross section confirms that 10nm SnO_2 is deposited by 150 ALD cycles

Increasing precursor partial pressures and exposure times facilitate deeper penetration into high aspect ratio nanopores while the conformality will be hindered with increased molecular mass of precursor. As aspect ratio increases, the exposure dose scales up quadratically, which means a substantial longer exposure time in order to provide saturation for the entire surface.

Therefore, it is of great importance to optimize the exposure dose for nanopore batteries since the metal contacts at the two ends of AAO pores will penetrate too deep and short the device if the precursor is over-dosed, while under-dosing the precursor will lead to too small the length of electrodes, which may jeopardize the battery performance when cycled at high rate. In this nanopore battery, the depth of Pt into AAO pores is optimized using exposure mode in a Fiji F200 reactor with APC valve closed during precursor pulse to facilitate precursor diffusion into high aspect ratio channels. Pt grows deep into the AAO pores with 30s Pt precursor exposure time while keeping the two electrode insulated.

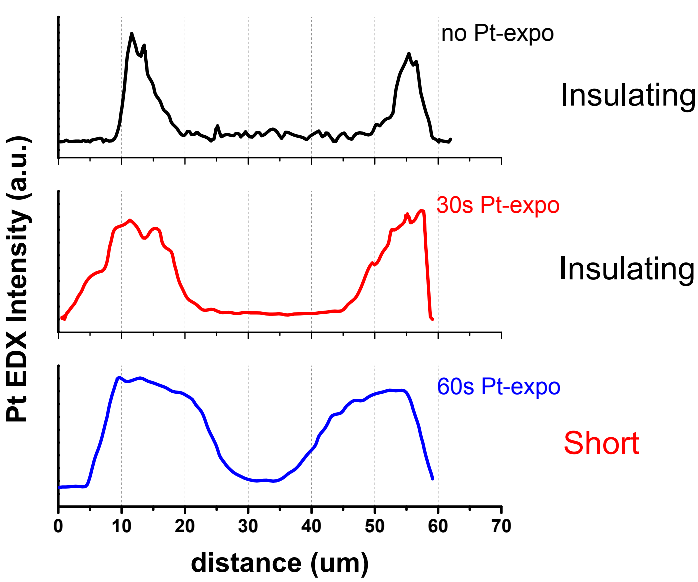

Figure S3. Pt EDS intensity line scan along AAO nanopore cross section with same Pt precursor pulse time and different precursor exposure time. The Pt electrodes at two sides of AAO are insulating with 0s and 30s exposure time, while they are shorted if the exposure time is increased to 60s.