אוניברסיטת בן-גוריון בנגב
Ben-Gurion University of the Negev

מכון אילזה כ"ץ למדע וטכנולוגיה בתחום הננומטרי
Ilse Katz Institute for Nanoscale Science and Technology

Nanotechnology Seminar, Wednesday 23.4.2014, 12:00

IKI Auditorium, Building 51, room 015

PATTERNED SINGLE LAYER IONIC CONDUCTOR

Jacob Sagiv

Department of Materials and Interfaces
Weizmann Institute

Abstract:

A conceptually new approach to nanoionics is described aiming at the generation of patterned ion conducting ultrathin films that enable effective spatial confinement of ionic traffic and related electrochemical processes to planned surface paths. *Constructive lithography* – an electrochemical patterning process of highly ordered organosilane monolayers carried out with the assistance of a conductive AFM tip (serial)[1-3] or stamp (parallel)[2,3] – is used to effect local conversion of the initially inert, electrically insulating outer surface of an OTS/Si monolayer to a highly efficient solid ionic conductor. Experimental results obtained from combined AFM, FTIR and electrical measurements conducted on this model system (Fig. 1) demonstrate:

(i) Successful fabrication of ion channel and ion field configurations extending from nanometers to centimeters; (ii) Confined lateral transport of different selected metal ions within predefined ion channel paths; (iii) Lateral (dry) electrochemical growth of particulate metal nanowires via discharge of mobile metal ions transported along the nano-channels.

Novel aspects of the mechanism of ion transport deriving from the unique structure of this generic single layer ionic material will be discussed, as well as its possible utilization in the creation of new types of ionic nanodevices.

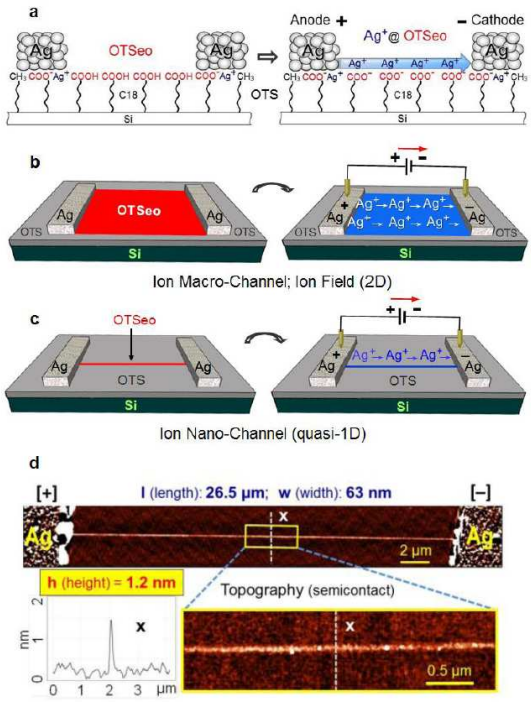

Figure. **a**, Schematic side view of monolayer on silicon with two silver electrodes positioned on its surface at boundaries between -COOH (OTSeo, ion-conducting) and -CH_3 (OTS, ion-insulating) surface regions, before (left side) and after (right side) application of a voltage bias that induces a steady lateral current of mobile Ag^+ ions on the dense array of fixed -COO^- ionic sites (0.2 nm^2/site) resulting from the displacement of protons from the initial OTSeo surface. **b**, Stamp-printed OTSeo macro-channel or large ion field. **c**, AFM-inscribed OTSeo ion nano-channel. **d**, AFM image of an ion nano-channel (as in **c**) taken after current flow for several seconds at a voltage bias of 1 mV, showing the rapid formation of a grainy silver nanowire with average height of ~1nm that spans the entire channel length. d

1. R. Maoz, E. Frydman, S. R.Cohen, J. Sagiv, *Adv. Mater.* **12**, 725 (2000).
2. A. Zeira, J. Berson, I. Feldman, R. Maoz, J. Sagiv, *Langmuir* **27**, 8562 (2011).
3. J. Berson, A. Zeira, R. Maoz, J. Sagiv, *Beilstein J. Nanotechnol.* **3**, 134 (2012).