Conductivity measurements of ordered arrays of Au particles prepared by nanosphere lithography

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Shadow Nanosphere Lithography (SNSL) is a low-cost, time-efficient method used for preparation of large-area, two-dimensionally ordered particle arrays. It utilizes monolayer of polymer spheres as a mask for metal evaporation process. Future morphologies of particles can be greatly extended if additional processing of the nano-sphere evaporation masks is carried, either by decreasing apertures by annealing or silica coating [1, 2] or increasing spacing of polymer spheres by reactive ion etching (RIE).

Variation of the geometry of evaporation setup during the process allows preparation of the simple morphologies such as ring, rod, and dot-shaped particles.
In distinction, if no variation or additional processing of masks is present, basic triangularly-shaped particles are produced.

If RIE is used as a post-processing of the evaporation mask, one can easily obtain metallic nanowires with precisely controlled spacing and dimensions (Fig. 1).

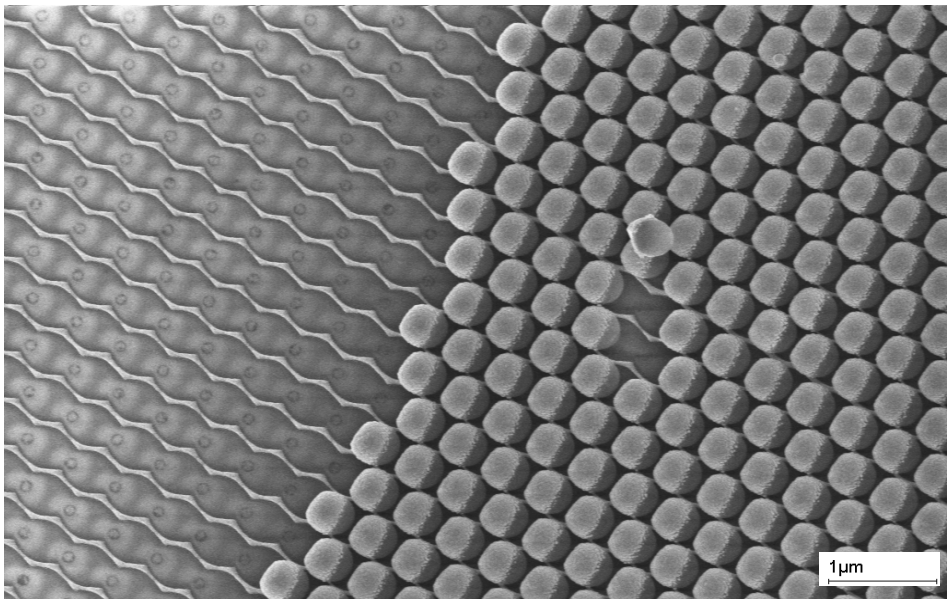

Fig. 1. Au nanowires evaporated through RIE processed mask of ordered 470 nm polystyrene nanoparticles.

Hereby we want to present the first measurements of conductivity of Au-nanowires and particles arrays, obtained by mentioned technique, as well as a preparation procedure of those.

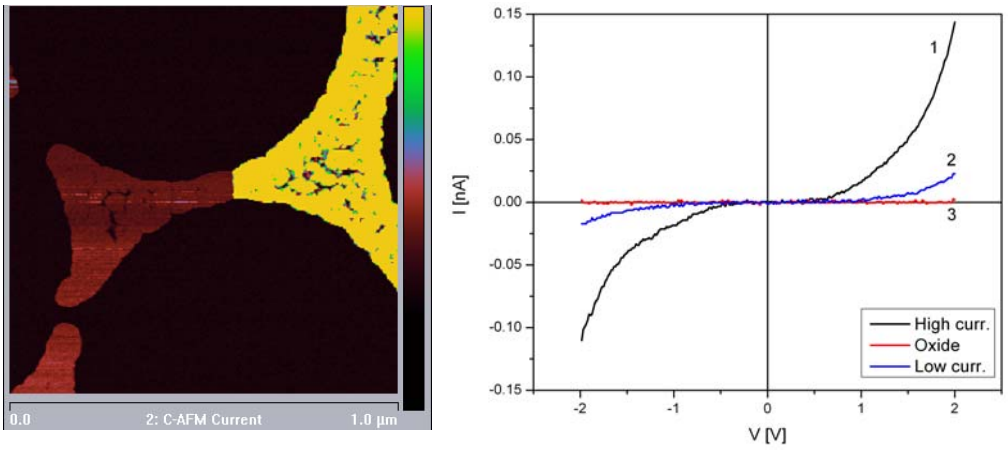

Fig. 2. C-AFM map of different triangular Au particles shows a very sharp boundary between 2 levels of conductivity arising from tunneling of electrons between particles and silicone substrate. Measured IV spectra shows typical semi-conductive characteristic, with a band *ca.* 1eV corresponding well to the Si substrate.

The conductive atomic force microscopy (C-AFM) carried by Dimension 4000 scanning probe shows interesting quantum effects obtained with this simple yet powerful technique (Fig. 2). The conductivity electrons are tunneled from Si substrate to the triangular Au nanoparticle. Because of various thickness of native oxides layer, current for each nanoparticle electrode has a uniform, unique value. This value is straightly correlated to a number of atomic oxide layers in the separation barrier.

[1] A. Kosiorek, W. Kandulski, P. Chudzinski. K. Kempa, M. Giersig, Nano Letters **4** (2004) 1359
[2] A. Kosiorek, W. Kandulski, H. Glaczynska, M. Giersig, Small **4** (2005) 439

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