Scanning probe microscopy and spectroscopy investigations of periodic magnetic nanoparticles prepared by the nanosphere lithography

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Scanning probe microscopy (SPM) and spectroscopy (SPS) were applied to study the morphology and nanoelectronic properties of periodic arrays of magnetic (Ni, Co) nanoparticles deposited on n-silicon substrates. Periodic magnetic nanoparticles were prepared by nanosphere lithography method (the mask – see Fig. 1) and subsequent evaporation of the magnetic material. The sample topography was imaged by means of scanning tunneling microscope (STM) and atomic force microscope (AFM). The images, as seen in Figures 2a and 2b revealed a perfectly ordered nanoparticles arrays with very good correlation to the latex mask. Magnetic force microscopy was used to examine the magnetic properties of individual particles. The results proved that the triangularly shaped islands (of about 300 nm side length) exhibit monodomain state as it is seen in Figs. 3a and 3b. Finally, tunneling spectroscopy measurements were performed with non-magnetic tip yielding information on the local

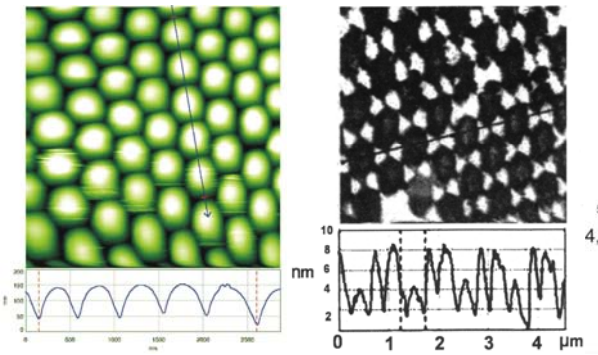

Fig. 1. Latex nanosphere mask.

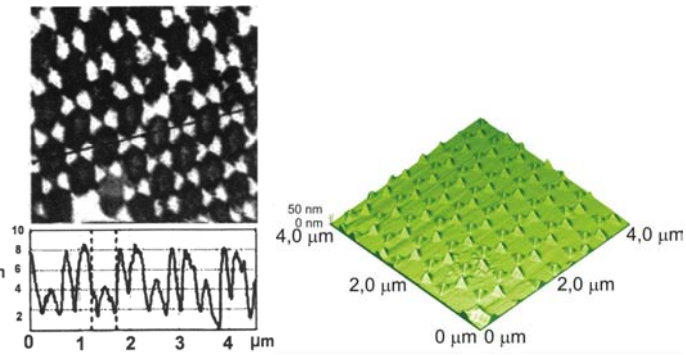

Fig. 2. (a) STM image and (b) AFM image of magnetic nanoparticle array.

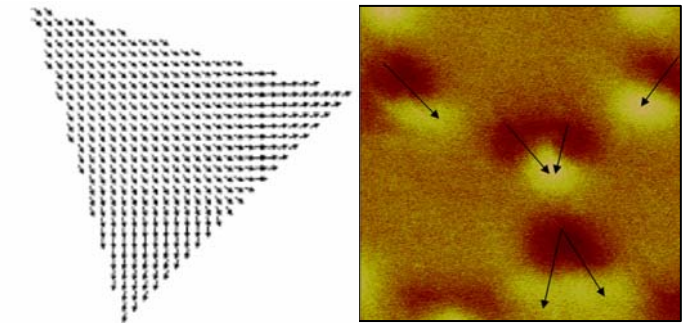

Fig. 3. (a) Model of the Y-shape of monodomain magnetic structure and (b) MFM image of the magnetic Ni nanoparticle.

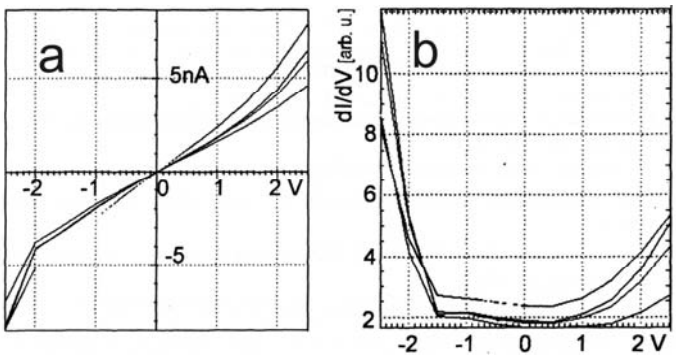

Fig. 4. I-V (a) and (dI/dV) vs. bias polarization curves measured above magnetic Ni nanoparticle.

electronic properties of nanoscale structures at the surface. Some typical I-V and dI/dV vs. bias voltage curves are shown in Fig. 4a and 4b.

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