Shaping surface potentials for the transport and assembly of nanoscale objects

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A growing variety of nanoscale building blocks with unique functionality such as semiconductor nanowires, metal nanorods, and semiconductor quantum dots is becoming available. They promise new and disruptive applications in nanoelectronic, optical, and sensing devices. For many such devices a precise placement and integration onto existing surface structures is required.
We developed a method based on fluidic confinement in a nano-slit [1] to transport [2] and precisely deposit [3] nanoscale building blocks. This method relies on 3D topographical surface potentials which are prepared by thermal scanning probe lithography (t-SPL) in a polymer resist with single nanometer accuracy in the direction of the surface normal [4]. The topographical features can also be transferred into oxide or semiconductor surfaces.
Along with demonstrating the transport and deposition of gold nanoparticles and semiconductor nanowires, we have also considered an asymmetrically charged biological system, namely purple membranes [5]. The membrane patches contain 2D crystals of the light-driven proton pump bacteriorhodopsin embedded in lipid bilayers. We demonstrate that we can transport and deposit the membranes with control over their final position, a first step towards artificial devices using the membranes as energy source.

References

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Figures

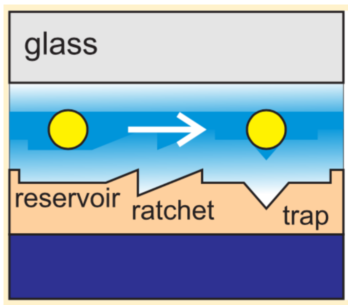

Figure 1: Transport and deposition of nanoscale objects in a nanofluidic gap with topographically shaped surface potentials [3].

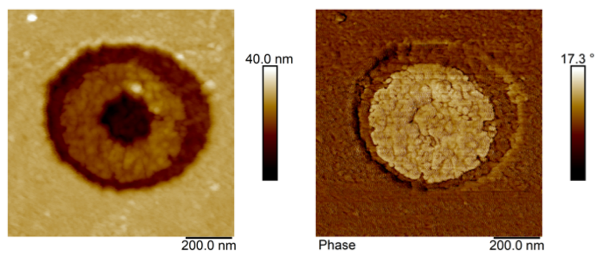

Figure 2: AFM images of a purple membrane patch deposited in nanofluidic confinement (left: topography, right: phase).