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FluidFM: a new Approach to Scanning Probe Lithography in Liquid

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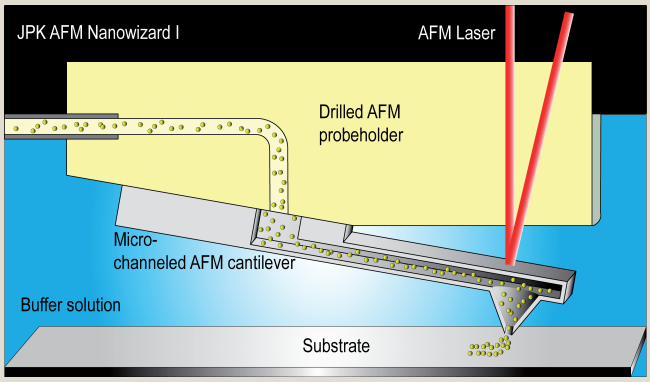
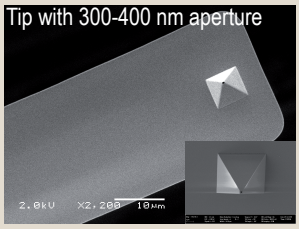
Fluid FM - Introduction



The FluidFM combines AFM technology with nanofluidics.

- Pressure controlled local liquid dispension of soluble molecules in air and in liquid.
- Tool for local chemistry: In situ reaction between activ agent in the channel and surface molecules.

Objectives

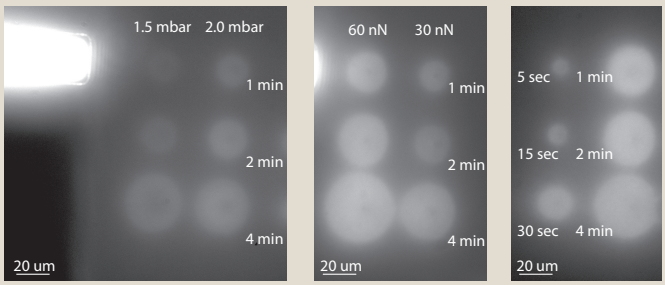


SEM image of FluidFM cantilever and pyramidal tip with aperture at the apex.

- Using FIB for milling the aperture and designing the angle between tip opening and substrate.
- Local deposition of polystyrene nanoparticles on glass in liquid.
- Fabrication of dots and nanolines
- Analysis of deposition parameters: line speed, pressure, force (setpoint).

Deposition of polystyrene nanoparticle spots

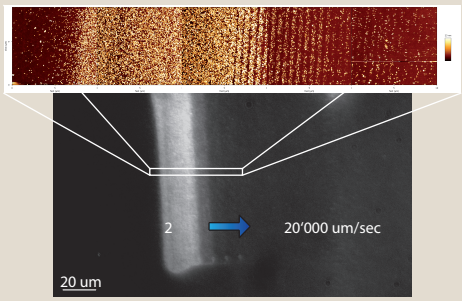
- Microchannel filled with fluorescent polystyrene nanoparticles (25nm diameter, functionalized with -COOH) dissolved in MilliQ-water.
- Pressure controlled deposition onto polyethylenimine(PEI)-coated glass-slide. PEI is a cationic polymer and serves as attachment promoter.
- Deposition in buffer solution (HEPES) for fixed tip position is dependent on pressure, force (setpoint) and time.



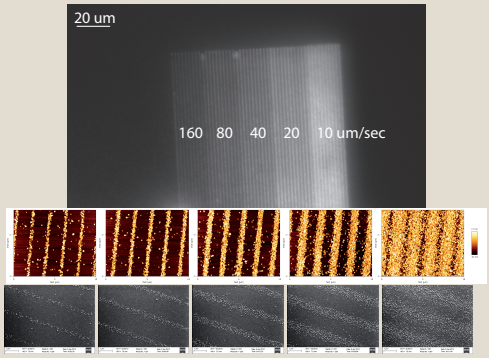
Fluorescence Microscope images for deposition of polystyrene napoparticles in dependence of pressure, force (setpoint) and time.

Drawing of polystyrene nanoparticle lines

- Moving the cantilever tip parallel to the surface in contact mode results in formation of polystyrene nanoparticle lines.
- Width and particle density are dependent on line speed and pressure.



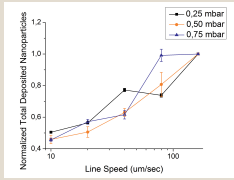
Fluorescence Microscope and AFM Topographic images for different line speeds and 0.25 mbar.



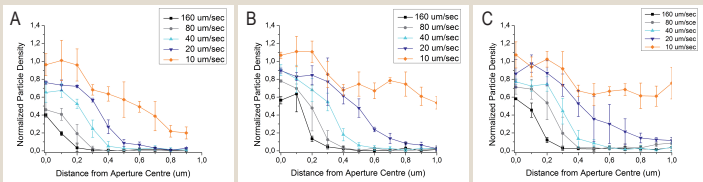
Fluorescence Microscope and AFM and SEM images for different line speeds and 0.25 mbar.

Analysis

- The particle flux onto the surface is largest for higher line speeds.
- The particle density profiles illustrate the deposition mechanism: For higher line speeds the particles are deposited exclusively in the confined region under the aperture. After coverage of this area the particles start diffusing away under the tip aperture edge.



Total deposited particles per time in dependence of line speed.



Particle density profiles for 0.25 mbar (A), 0.50 mbar (B) and 0.75 mbar (C).

Perspectives

- Fabrication of conductive nanowires by local deposition of gold nano-particles for electrical interconnection of conductive objects on an insulating surface.