Tip-Based Nanofabrication and Nanometrology of Functional Nanodevices using Heated Cantilever Arrays

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This talk describes tip-based nanofabrication and nanometrology using heated cantilever probe tip arrays. When the heated tip of an atomic force microscope (AFM) cantilever is in contact with a substrate, the tip-substrate contact is a hotspot that can be smaller than 10 nm. We use this nanometer-scale hotspot for local thermal processing. In one approach, we can use the tip heating to control the deposition of polymers or nanoparticles from the tip onto a surface.[1,2] In another approach, the heated tip can induce local temperature-activated chemical reactions.[3]

The heated tip can perform both writing and reading. Because each tip can be addressed individually, the writing and reading can be scaled to large arrays.[4] In array operation, the reading resolution is near 1 nm. We demonstrate array writing and reading of sub-100 nm nanostructures with tip speed up to 1 mm / sec. The cantilever tips are made of nanocrystalline diamond, and have little or no wear at these speeds.[5]

Unlike many scanning probe lithography approaches that require specialty hardware, this nanolithography capability is enabled by our integration of heated AFM cantilevers in a commercial AFM system. We describe our hardware and software integration of the cantilever array, which could be adapted to any AFM.

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