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Imaging and manipulation of nanoscale materials with coaxial and triaxial AFM probes KEITH A. BROWN, R.M. WESTERVELT, Harvard SEAS and Physics — We present coaxial and triaxial Atomic Force Microscope (AFM) probes and demonstrate their applications to imaging and manipulating nanoscale materials. A coaxial probe with concentric electrodes at its tip creates a highly confined electric field that decays as a dipole field, making the coaxial probe useful for near field imaging of electrical properties. We show nearly an order of magnitude improvement in the step resolution of Kelvin probe force microscopy with coaxial probes. We further demonstrate that coaxial probes can image dielectric materials with the dielectrophoretic force. In addition to imaging, the capacitive structure that makes up the cantilever of a coaxial probe is used to locally mechanically drive the probe, making them self-driving probes. Finally, coaxial probes can create strong forces with dielectrophoresis (DEP) which we combine with the nanometer precision of the AFM to create a nanometer scale pick-and-place tool. We demonstrate 3D assembly of micrometer scale objects with coaxial probes using positive DEP and discuss the assembly of nanometer scale objects with triaxial probes using negative DEP.

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