# AFM measurements of time-varying nanomechanical forces

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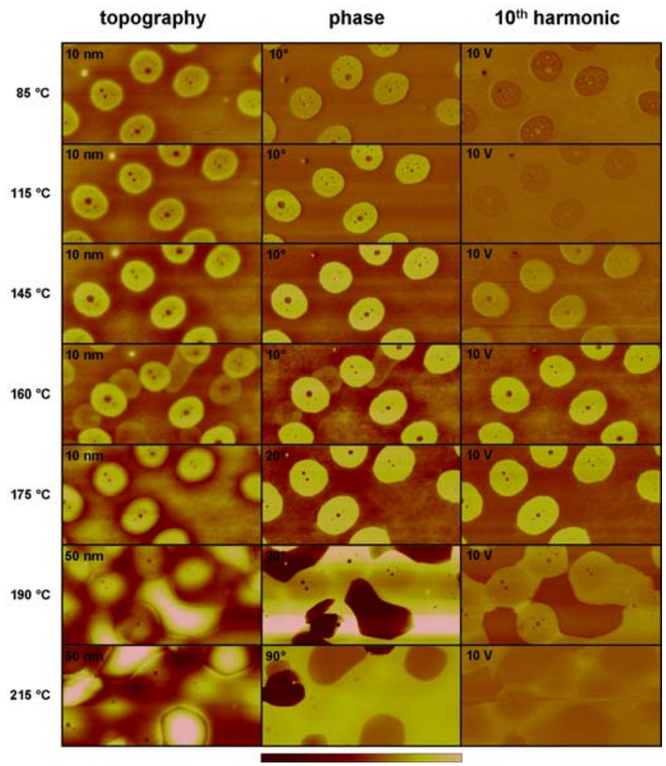
In tapping-mode AFM, which is the most common AFM imaging modality, the tip experiences attractive and repulsive forces that depend on the chemical and mechanical properties of the sample. Yet conventional AFMs cannot resolve these time-varying forces, so data on chemistry and mechanics are lost. We have created a cantilever that measures these interaction forces with good (sub-microsecond) temporal resolution, so that material properties can be determined and mapped in detail with nanoscale spatial resolution. The forces and contact areas encountered in these measurements are orders of magnitude smaller than conventional indentation and AFM-based indentation techniques. We use this tool to quantify and map nanomechanical changes in a binary polymer blend in the vicinity of its glass transition.




Topography, phase, and 10th harmonic images of a thin polymer film composed of polystyrene and PMMA recorded at different temperatures. Brighter color represents larger height, phase, or harmonic amplitude. Scan area is 2.5 by 5 um. The color bar represents different height and phase ranges at each temperature. For each topography and phase image the corresponding ranges are given on the top left corner. For the harmonic images the color bar represents 10 V lock-in output signal at all temperatures. Note that height and phase contrast increases with temperature, whereas the harmonic contrast is first increasing and then decreasing.

REFERENCE:
O. Sahin, S. Magonov, C. Su, C.F. Quate, O. Solgaard, “An atomic force microscope tip designed to measure time-varying nanomechanical forces”, Nature Nanotechnology 2, pp. 507-514, 29 Jul 2007.