High-Bandwidth Atomic Force Microscopy Imaging in Fluids

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Interdigitated AFM probes open the bandwidth of traditional AFM, allowing detailed force curves to be generated during tapping mode imaging. The high mechanical bandwidth of the integrated diffraction-grating-based force sensor enables measurement of fast varying tip-sample interaction forces. For imaging in fluids, we implemented a signal processing scheme to calculate the tip-sample interaction force as well as elastic properties from high-frequency photodiode signals. Using this method, we imaged a styrene-(ethylene/butylene)-styrene (SEBS) copolymer sample submerged in water and obtained spatial maps of elastic properties as well as maps of higher harmonics of the tip motion. We observed that multiple physical quantities contribute to the contrast observed in the phase and higher harmonic images. We have also applied this technique to cellular imaging where physical measurements of cells that previously took days are acquired in minutes.