Scanning Probe Microscopy Focus Topic
Room: Hall B - Session SP+AS+BI+NS-ThP

Scanning Probe Microscopy Poster Session
Moderator: S. Allen, The University of Nottingham, UK, A.P. Li, Oak Ridge National Laboratory

SP+AS+BI+NS-ThP1 Vision Sensing Based Drift Measurement and Compensation in Real Time for Atomic Force Microscope, ***Y. Wang***, Beihang University, China, *H. Wang,* The Ohio State University*, S. Bi*, Beihang University, China

Atomic force microscope (AFM) is unique in its capability in measuring deformation and force in subnanometers and has been a crucial tool in nanoscale science and technology since its invention. However, mechanical drift between AFM cantilevers and sample surfaces limits its applications, especially for some biological experiments which require long time measurement. In this study, the mechanical drift is obtained in real time by simultaneously measuring the *z* position of AFM cantilevers and sample surfaces through an off-focus image processing based vision sensing method. In this method, the *z* position of a micro bead is measured by processing the off-focus images of the bead with an optical microscope. To get the *z* position of an AFM cantilever, the cantilever is first fabricated with focused ion beam (FIB) and a micro bead is attached to the end of the cantilever. Another bead is placed on a transparent sample substrate. The *z* positions of the AFM cantilever and the sample surface can be simultaneously obtained through measuring the *z* position for the beads at end of the AFM cantilever and the sample surface, respectively. The mechanical drift between the cantilever and sample surface can be obtained and then compensated in real time.

SP+AS+BI+NS-ThP2 Rapid Near-Field Infrared Spectroscopy Using an External Cavity Quantum Cascade Laser, *I.M. Craig, M.S. Taubman, M.C. Phillips,* ***A.S. Lea****,* Pacific Northwest National Laboratory*, M.B. Raschke*, University of Colorado at Boulder

Scattering scanning near-field optical microscopy (*s*-SNOM) is an apertureless superfocusing technique that uses the antenna properties of a conducting atomic force microscope (AFM) tip to achieve infrared spatial resolution below the diffraction limit. The instrument can be used either in imaging mode, where a fixed wavelength light source is tuned to a molecular resonance and the AFM raster scans an image, or in spectroscopy mode where the AFM is held stationary over a feature of interest and the light frequency is varied to obtain a spectrum. In either case, a strong, stable, coherent infrared source is required. Here we demonstrate the integration of a broadly tunable external cavity quantum cascade laser (ECQCL) into a *s*-SNOM and use it to obtain infrared spectra of microcrystals adsorbed onto gold substrates.

Residues of explosive compounds PETN, RDX, and tetryl were deposited onto gold substrates. *s*-SNOM experiments were performed in the 1260–1400 cm^{-1} tuning range of the ECQCL, corresponding to the NO_2 vibrational fingerprint region. Chemical imaging with fixed wavelength tuned to a molecular resonance allows mapping of species distributions a spatial resolution of ↾ 25 nm. Vibrational infrared spectra are then collected on individual chemical domains with a collection area of ↾ 500 nm^2. Acquisition times of less than 6 min with SNR of >50 and 0.2 cm^{-1} spectral resolution are possible. Spectra are compared to ensemble averaged far-field infrared reflection-absorption spectroscopy (IRRAS) results.

SP+AS+BI+NS-ThP3 Ferritin-based Magnetic Force Microscopic Probe with Very High Resolution, ***N. Chung****,* Korea Research Institute of Standards and Science, Republic of Korea*, D.H. Kim, J.W. Park*, Pohang University of Science and Technology, Republic of Korea

A single-molecule ferritin picking up process was realized with the use of AFM, which was enhanced by employing controlled dendron surface chemistry. The approach enabled the placement of a single ferritin protein molecule at the very end of an AFM tip. When used for magnetic force microscopy (MFM) imaging, the tips were able to detect magnetic interactions of approximately 10 nm sized magnetic nanoparticles. The single ferritin tip also showed the characteristics of a "multifunctional" MFM probe that can sense the magnetic force from magnetic materials as well as detect the biomolecular interaction force with DNAs on the surface. The multifunctional tip enabled us not only to investigate the specific molecular interaction but also to image the magnetic interaction between the probe and the substrate, in addition to allowing the common capability of topographic imaging. Because the protein engineering of ferritin and the supporting coordination and conjugation chemistry are well-established, we envisage that it would be straightforward to extend this approach to the development of various single magnetic particle MFM probes of different compositions and sizes.

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