

Infrared vibrational nanospectroscopy via molecular expansion force detection

Mikhail Belkin

Department of Electrical and Computer Engineering, The University of Texas at Austin
<http://www.ece.utexas.edu/~mbelkin>

ABSTRACT

I will present a technique for very sensitive mid-infrared vibrational nanospectroscopy based on observing a deflection of an atomic force microscope cantilever due to mechanical forces exerted by molecules excited with laser pulses. Spectra are obtained by recording the cantilever deflection amplitude as a function of excitation laser wavelength. Tip-enhancement of light intensity and mechanical cantilever resonance enhancement are used to achieve nanoscale spatial resolution and ultrahigh sensitivity. Non-destructive mid-infrared spectroscopy and imaging of molecular monolayer islands is demonstrated in air with high signal-to-noise ratio and better than 30 nm spatial resolution. Approximately 300 molecules contribute to cantilever deflection in our current experiments and spectra of as few as 30 molecules would be detectable. We have also demonstrated that this technique can be extended to imaging of samples in liquid and demonstrated mid-infrared spectroscopy and imaging of 20-50 nm thick polymer films with approximately 30 nm spatial resolution.

Biography: Mikhail Belkin received his BS in Physics and Mathematics from Moscow Institute of Physics and Technology in 1998 and PhD degree in Physics from the University of California at Berkeley in 2004. In 2004-2008 he worked in the group of Prof. Federico Capasso in the Harvard School of Engineering and Applied Sciences. In the Fall of 2008 he joined the faculty of the ECE department of the University of Texas at Austin, where he is currently an Associate Professor and General Motors Foundation Centennial Teaching Fellow. Dr. Belkin's research interests are in the field of mid-infrared and THz photonics and nonlinear optics. His recent recognitions include the 2015 Friedrich Wilhelm Bessel Research Award from the Humboldt Foundation, 2014 Tour Speaker award from the Society for Applied Spectroscopy, the NSF CAREER Award, the DARPA Young Faculty Award, and the AFOSR Young Investigator Program Award. Dr. Belkin is the Fellow of the OSA and the Senior Member of IEEE.