Noncontact AFM Capacitive Measurements

by

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Birck Nanotechnology Center
Room 1001

Pizza lunch begins at 11:30 AM

In the last decade, various groups have successively attempted to characterize the local dielectric properties of surfaces and thin films at the nanoscale using atomic force microscopy. I first review these techniques and then present an additional one.

Although these methods are convenient to use and can be applied to a wide range of materials, the accuracy is limited by the low sensitivity of the cantilever detection. As a result, high bias potentials (typically > 1 V) have to be applied between the tip and the sample to get a high signal-to-noise ratio. For highly polarizable dielectric materials, large electric fields between the tip and the substrate may result in non-linear effects and dielectric breakdown, thus complicating the capacitive force modeling. In addition, the use of high electric fields may damage soft materials like self-assembled monolayers and biological matter.

We have developed an additional technique which addresses these difficulties, and I show that multi-frequency non-contact AFM in air can measure capacitive forces and the dielectric constant of ultra-thin films on metal substrates, giving 2.0 ± 0.1 for self-assembled monolayers of alkanethiols and 3.6 ± 0.07 for sputtered SiO_2 on gold, in good agreement with previous measurements, while employing sub-Volt potentials and benefitting from the enhanced sensitivity of higher-mode cantilever vibrations.

Scott is a recent graduate from Purdue with a PhD from Physics in 2004.