Molecular Recognition Using Nanomechanical Sensors

Thomas Thundat
Oak Ridge National Laboratory
Oak Ridge, TN 37831

The realization that many molecular phenomena result in mechanical responses at the nanoscale promises to bring about a revolution in the field of chemical and biological sensor development. Exploiting nanoscale mechanics for molecular recognition is paradigm shift in sensor technology. Micromachined silicon cantilever is an ideal tool for observing the mechanical forces involved in the adsorption process, when the adsorption is confined to a single side of the cantilever beam. In addition, the resonance frequency (Brownian motion) of the cantilever beam varies sensitively as a function of molecular adsorption. Chemical selectivity is achieved by coating the cantilevers with selective molecules such as self-assembled monolayers (SAM). It is postulated that the cantilever bending depends on the changes in surface free energy while the resonance frequency variation is entirely due to mass loading (both specific and nonspecific adsorption). This process can be used for elucidating adsorption process. Micromachined arrays can be sued for the simultaneous detection of multiple analytes. Recent results from cantilever array sensors will be discussed.