Nanomechanical Systems: From Molecular Recognition to Energy Conversion

Prof. Thomas Thundat
Canada Excellence Research Chair
Chemical and Materials Engineering Department,
University of Alberta, Edmonton, Canada T6G 2V4

The realization that many interfacial molecular phenomena result in mechanical responses at the nanoscale level, together with recent advances in fabricating devices for measuring forces with extremely high resolution, offer unprecedented opportunities for developing sensors with very high sensitivity. In spite of their high sensitivity, chemical selectivity in micro- and nanofabricated sensors has been a challenge. However, the low thermal mass of these miniature sensors offers a unique opportunity for modulating the physical properties of adsorbed molecules using external stimuli such as infrared radiation. Using this approach, we have demonstrated extremely high selectivity and sensitivity for detection of physisorbed chemical and biological molecules. Recently, we have been able to extend this concept for obtaining infrared spectra of picolitres of liquids in a hollow channel cantilever. While the science underlying chemical-to-thermal-to-mechanical energy transduction is still being explored, the technological potential can truly be realized if multiple interactions can be detected simultaneously. In addition, these mechanical systems have the potential to be used for energy harvesting. This talk will focus on both the scientific understanding, as well as the technological progress in the development of nanosystems for chemical sensing as well as energy harvesting. I will also discuss recent developments in powering miniature sensors using a single wire power transmission technique.