MEMS BIOSENSOR WITH INTEGRATED IMPEDANCE SPECTROSCOPY AND GRAVIMETRIC MEASUREMENTS FOR WATER TOXICITY TESTING

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In this seminar, the design, fabrication and characterization of a multiparametric biosensor based on mammalian cells will be presented. This biosensor combines two biosensing techniques; resonant frequency measurements and electric cell-substrate impedance sensing (ECIS) on a single chip. The biosensor is able to simultaneously perform in real-time two different types of electric measurements on the same cell monolayer: (1) monitoring the resonant frequency values that will give information about the progression of cells adhesion and cell viscoelasticity and, (2) recording the impedance spectra of the cells, that will report on cell adhesion progress, shape, growth, motility and viability. The sensor is based on the innovative placement of the working microelectrode for ECIS technique as the upper electrode of a quartz crystal microbalance (QCM) resonator. Bovine aortic endothelial cells (BAECs) with different densities were used as sensitive cells.

In the seminar the fabrication process of the biosensor will be discussed. Impedimetric and gravimetric measurements conducted with this cell-based hybrid biosensor will be explained. Cell damage induced by toxic water will result in the decrease in impedance, as well as increase in the resonant frequency. The effects of the toxicants: ammonia, nicotine and aldicarb on cells were monitored with both sensors; the QCM and the ECIS technique. The lab on chip was demonstrated to indicate low concentration of toxicants. The responses of BAECs to toxic samples occurred during initial 5 to 20 minutes depending on the type of chemicals and concentrations. A highly linear correlation between signal shifts and chemical concentrations was demonstrated for each toxicant.

Ioana Voiculescu is Associate Professor at City College of New York in the Mechanical Engineering Department. She has a doctoral degree from Politehnica University in Romania in Mechanical Engineering from 1997. In 2005 she graduated with a second doctoral degree in the area of MicroElectroMechanical Systems (MEMS) from The George Washington University in Washington DC. She is the author of two US patents, and several journal and conference papers. During her doctoral degree studies she performed research at Naval Research Laboratory (NRL) in Washington, DC. Her research interests are in the area of Microelectromechanical (MEMS) sensors for biological and chemical applications, lab on chip devices, MEMS cantilever beam and stretchable, flexible and wearable electronics and devices.