NANOHOUR

Wednesday, April 18, 2012 3:00 pm
Beckman Institute - Room 3269

High-Temperature Piezoresponse Force Microscopy

Bikram Bhatia, Mechanical Science and Engineering
Graduate Student with Professor William P. King

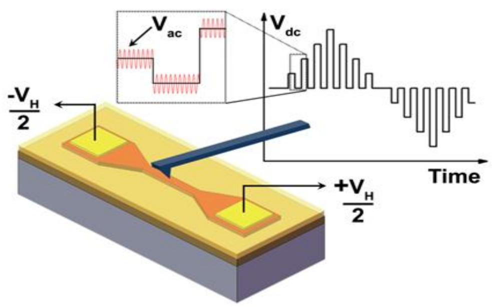
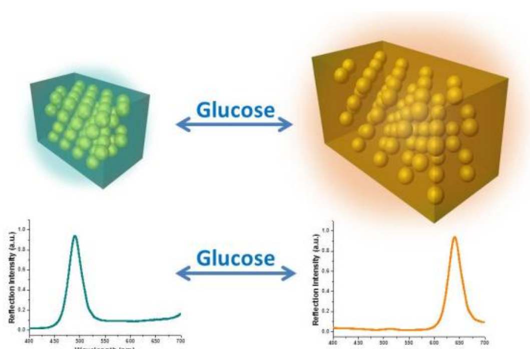


Figure. Schematic of the experimental setup. PZT thin film is deposited on the microfabricated heater structure which can be resistively heated. The voltage waveform applied to the conductive AFM tip for local hysteresis measurements is shown.

Temperature governs the properties of ferroelectric materials, however high temperature characterization is challenging in conventional atomic force microscopy (AFM). We present an AFM technique to study the nanometer-scale electronic properties of ferroelectric films using a microfabricated platform that allows local temperature control up to 1000^{o}C. High temperature piezoresponse force microscopy is performed on $PbZr_{0.2}Ti_{0.8}O_3$ (PZT) thin films fabricated on the micro-heater stage. Theory predicts that piezoelectric coefficient (d_{33}) increases with temperature and diverges at the Curie temperature. However previous AFM measurements did not observe this effect due to the dominance of electrostatic interactions over the ferroelectric electromechanical response. We have been able to minimize the electrostatic and non-local interactions between the conductive tip and the sample by virtue of our tip-sample orientation relative to our extremely small microfabricated heater. The piezoresponse increases with temperature and then decreases rapidly near 400^{o}C, which is indicative of the ferroelectric-paraelectric phase transition.

Photonic Crystal Glucose Sensor Materials

Chunjie Zhang, Materials Science and Engineering
Graduate Student with Professor Paul Braun



People who suffer severe physical injuries, heart attack, amputation, stroke and surgery are usually cared for in the intensive care unit (ICU). The stress of such traumatic events malignantly elevates blood glucose. Elevated blood glucose (stress induced hyperglycemia) as a result of an acute health event is independent of the presence of diabetes prior to the trauma and adversely affects recovery. In fact, stress induced hyperglycemia occurs in approximately three-fourths of acute patients who do not suffer from diabetes prior to the acute event. It was recently shown that maintaining blood glucose within a normal range of 80-110 mg/dL, referred to as Tight Glycemic Control (TGC), reduces ICU morbidity and mortality by 42%. ICUs across the country are now implementing TGC protocols, but they need an automated continuous glucose monitor that is highly responsive to blood glucose change to achieve the full benefits of a TGC program.

Herein, we have developed a series of photonic crystal glucose sensor materials that diffract light, and the wavelength of diffracted light is related to glucose concentration. The sensors contain a hydrogel matrix with a self-organized highly ordered array of polystyrene colloids. Molding technique reduces forces on the spheres that can lead to array irregularities. Processes to fabricate the sensor have been studied to determine parameters to produce required response. The material responds linearly over the blood glucose range, producing around 200 nm wavelength blue shift. The sensor material will be protectively placed at the tip of an optrode catheter suitable for positioning in a blood vessel.

Coffee and cookies will be served

http://nanohour.beckman.illinois.edu