ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ ΥΛΙΚΩΝ

ΠΡΟΣ

1) **Ολα τα μέλη ΔΕΠ του Τμήματος Επιστήμης και Τεχνολογίας Υλικών**
2) **Τους εκπροσώπους των Μεταπτυχιακών φοιτητών του Τ.Ε.ΤΥ**

3) **Την Επταμελή Εξεταστική Επιτροπή**
4) **Ολα τα μέλη της Πανεπιστημιακής Κοινότητας**

Πρόσκληση σε Δημόσια Παρουσίαση της Διδακτορικής Διατριβής του

κ. Μητσακάκη Κωνσταντίνου

(Σύμφωνα με το άρθρο 12 του Ν. 2083/92)

Την Παρασκευή 11 Δεκεμβρίου 2009 και ώρα 13:00 στην αίθουσα Σεμιναρίων 3 ορόφου-Φυσικό

θα γίνει η δημόσια παρουσίαση και υποστήριξη της Διδακτορικής Διατριβής του υποψηφίου διδάκτορος του Τμήματος Επιστήμης και Τεχνολογίας Υλικών κ. **Μητσακάκη Κωνσταντίνου** με θέμα:

" Development of a multi-analyte acoustic biosensing platform for clinical diagnostics "

ABSTRACT

This work focuses on the development of a multi-analyte biosensor, based on a Surface Acoustic Wave (SAW) device. The novelty of the concept lies in the way of achieving multiplicity: instead of the "traditional" way of a sensor element array, multiplicity is induced by compartmentalization of a single sensor, achieved via microfluidics ("microfluidics-on-SAW", or "μF-on-SAW" setup).

Initially, the appropriate SAW device for the microsystem was selected among twelve device configurations (varying in substrate, operating frequency and waveguide thickness) upon loading with different classes of materials (mass, viscous, viscoelastic). In particular, a dual quartz-based SAW biochip was used, operating at 155 MHz with 0.70 μm thick PMMA waveguide. Subsequently, the microfluidic module was designed targeting flexibility and simplicity. Considering functional and geometrical limitations imposed by the SAW biochip, the two components were successfully assembled. The fabrication process for the microfluidic module was soft

lithography of PDMS (rapid prototyping and replica molding); 3-, 4-, and 5-channel modules were made, all successfully tested, and the 4-channel one used in the project.

Reproducibility and sensitivity tests were carried out using aqueous glycerol solutions, and standard protein biomolecules (neutravidin and biotinylated BSA, as well as protein G and IgG). The standard deviation in the signal values among the sub-areas was less than 10%, in all cases.

The proof-of-principle of multi-sample detection was achieved via four biotinylated molecules. Each one was injected in one μF-on-SAW compartment and interacted with pre-adsorbed neutravidin; separate detection of the analytes, kinetics and equilibrium analysis were successfully demonstrated. Maximum multiplexity was achieved when the two devices of the biochip were pre-functionalized with different receptors, and four different samples were injected in each microchannel (altogether 8 probed interactions).

The final step was the application of μF-on-SAW in multi-sample detection of clinical significance. In particular, cardiac markers were used, the detection of which was realized via antibody-antigen interactions. The four cardiac markers (CKMB, CRP, D-dimer, and PAPP-A) were successfully detected individually and in various concentrations; analytical curves were created for each biomarker and correlation to the known physiological and pathological values was made. Eventually, by using the μF-on-SAW it was feasible to selectively capture each marker out of a mixture or all four, a proof that the system can potentially be used in body fluids (were many "unwanted" species are present).

Finally, from the different groups of biomolecules detected throughout the project, interesting results emerged concerning the interaction of acoustic waves with biomolecules and the correlation of the acoustic signal with inherent properties of biomolecules such as their molecular weight and viscoelastic nature.