Dottorato in Scienza dei Materiali e Nanotecnologie

UNIVERSITÀ degli STUDI di CATANIA

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Prof. Yosi Shacham-Diamand, The Bernard L. Schwartz chair for nano scale information technologies, Department of Electrical Engineering - Physical electronics and the department of Material science and technology, Faculty of Engineering, TAU.

SEMINARIO: Printed Nano-Particles Based Bio Sensors
Prof. Y. Shacham-Diamand (Tel Aviv University)
DFA UniCT, Aula E – 02/03/2018, ore 10:00

Additive patterning of functional electronic materials allows low cost and high throughput fabrication method producing integrated sensors on both rigid and flexible substrates. In this work, we present recent results on nanoparticles printed by inkjet printing, electroplating and by cluster beam deposition. Inkjet direct patterning has advantages of being low cost, low waste and simple; however, the nanoparticles are in an ink media which needs extra care. Electroplating of gold nanoparticles is unique method depositing selectively on polypyrrole high quality nanoparticles with relatively large distribution in size. Cluster beam deposition yields high quality nanoparticles with very narrow size and shape distribution that can be tailored to many substrate; however, it requires high vacuum deposition systems which are typically of cost and lower throughput when compared to Inkjet or laser printing for example. Additionally, we present a way to modify the nanoparticle characteristics using electroless plating of gold and their modification using other electroless and electroplating processes.

We present few sensor types, suitable for flexible substrates, the first is a bio-electrochemical device made by ink-jet printed seed on polyimide substrate followed by two gold plating steps: electroless plating (AuELD) followed by electroplated (AuELP). After a short description of the electrodes we present the electrical properties of the thin film and their bio-electrochemical sensing properties. The second is a device made by gold nanopartoles on polypyrrole. The last one is a family of devices based on conjugate polymers (e.g. polyaniline, polypyrrole) modified with gas phase clusters. Three types of cluster beam sources were utilized; 1. Laser ablated Pt and Pt:Ni clusters deposited on PANI were utilized for dopamine sensing. 2. Au cluster assembled film implanted on PDMS were used for electroless plating and enzyme bio sensing. 3. Au cluster deposited using magnetron source on polypyrrole were used for electroless plating.

Finally, we present few results of bio electrochemical sensors. For example, specific gold nanoparticle modified polypyrrole electrode chips were tested for enzymatic sensors, sensing p-aminophenol (pAP) which is a common product in enzymatic reactions in whole cell bio sensor. The electrodes demonstrated sensitivity of 8.3mA/mM and limit of detection of 1.5µM with 91% specificity for the detection of alkaline phosphatase (ALP) enzyme in the presence of the ascorbic acid. Another example is sensor based on inkJet printed silver nanoparticles coated with electroless gold sensing Alkaline Phosphatase enzyme in the presence of its substrate, *p*-Aminophenyl Phosphate. The electrodes demonstrated a sensitivity of 11.8µA/mM and a limit of detection of 0.9mM.

Keywords: Bioelectrochemical sensors, additive manufacturing, nano particles.