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הפקולטה להנדסה כימית
ע״ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

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Room 6

Advances Electrochemical Methods for Plant Biosensing

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One of the most significant hurdles in development of precision agricultural systems is sensors which reliably gather accurate data, fast, non-destructively, and at low cost. Plant-based functional sensors, i.e., sensor systems in which the plants themselves function as the sensory mechanism, have been proposed as a potential solution to overcome this hurdle.

In this study we developed new advanced methods for plant-based electrochemical biosensing in three directions. The first approach was the demonstration of redox cycling amplification in plant-based sensors. Redox cycling is an electrochemical process in which the product of the redox reaction is converted into a reusable product. Overall, the molecule transfers charges during every successive reaction, effectively amplifying the detected current per molecule. The plant sensors measured the stress level of the tobacco plant using a combined enzymatic- electrochemical process that detects the enzyme level in the plant stem. The electrochemical amplification at an interdigitated electrode array (IDA) increased the signal level by a factor of ten and improved the detection rate. The second approach focused on development of a computational model of redox cycling in a flow chamber. It was shown that the applied flow deforms the diffusion layers and improved the mass transport between adjacent electrodes. The dependence of current in flow rate behaves as a diffusion-dependent regime at low rates and convection-dependent regime at higher rates. Thirdly, in order to optimize the sensor's contract to the plant, we designed and fabricated new flexible electronics methods based on supersonic cluster beam deposition and femtosecond laser ablation. We were able to pattern 3 μm electrodes of gold nanoparticles in PDMS nanocomposite film.