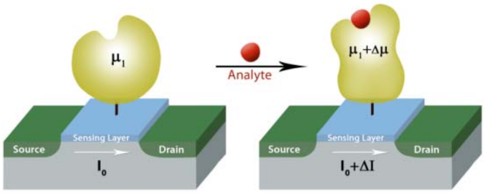
Richard - Willstätter Lecture of the GDCh

Lecturer: **Prof. Shlomo Yitzchaik**, Institute of Chemistry, and the Krueger Family Center for Nanoscience and Nanotechnology, The Hebrew University of Jerusalem, Israel

Title: **Molecular Interfaces in Neuroelectronic Hybrids**

Abstract: In this contribution we report on fundamental studies that explore the route for molecular tuning of silicon's electrical properties. The developed molecular electronics tools enabled the transduction of molecular-recognition events into measurable potentiometric signal. It is shown for the first time that bio-recognition of acetylcholine (ACh) can be translated to conformational changes in the enzyme, acetylcholine-esterase (AChE), which in turn induces a measurable change in surface potential. Our results show that a highly sensitive detector for ACh can be obtained by the dilute assembly of AChE on a depletion type floating gate derived field effect transistor (FG-FET). A wide concentration range response is observed for the neurotransmitter ACh (10^{-2}-10^{-9}M) and for AChE inhibitor, carbamylcholine – CCh, (10^{-6}-10^{-11}M). These enhanced sensitivities are modeled theoretically and explained by the combined response of the device to local pH changes and molecular dipoles variations due to enzyme-substrate recognition event.



Integration of neurons with microelectronic devices has been a subject of intense studies over the last decade. One of the major problems in assembling efficient neuro-electronic hybrid systems is the weak electrical coupling between the components. This is mainly attributed to the fundamental property of living cells to form and maintain an extracellular cleft between the plasma membrane and any substrate to which they adhere. This cleft shunts the current generated by propagating action potentials and thus reduces the signal-to-noise ratio. Reducing the cleft thickness and thereby increasing the seal resistance formed between the neurons and the sensing surface is thus a challenge and could improve the electrical coupling coefficient. Using electron microscopic analysis, and field potential recordings, we examined here the use of gold micro-structures which mimic dendritic spines in their shape and dimensions to improve the adhesion and electrical coupling between neurons and microelectronic devices. We found that neurons cultured on gold spines matrix, functionalized by a cysteine terminated peptide with a number of RGD repeats, readily engulf the spines, forming tight membrane-spine apposition. The field potentials generated by action potentials of cultured Aplysia neurons are significantly larger in neurons cultured on gold spine electrodes in comparison with the field potentials recorded by flat electrodes.

Date: **Wednesday, 9 December 2009**

Time: **5:15 pm**

Location: **TUB, Institute of Chemistry, Building C**
Strasse des 17. Juni 115, 10623 Berlin
Room C 243

Coffee and tea will be served from 4:45 pm.

Prof. Dr. Andreas Grohmann, Technische Universität Berlin, Institut für Chemie