北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Regenerative Nanowire FET Biosensors to Quantify Biomolecular Interactions

Xuexin Duan（段学欣）

天津大学精密仪器与光电子工程学院

Time: 4:00pm, Jan.15, 2014 (Wednesday)

时间：2014年1月15日 （周三）下午4:00

Venue: Room 607, Conference Room A , Science Building 5

地点：理科五号楼607会议室

Abstract

In the last decade, silicon nanowires configured as field effect transistors (Si NW-FETs) have been demonstrated to be capable of detecting a variety of biomolecular interactions below sub-picomolar concentrations. However, most of these sensors can be (practically) used only once, which limited the reproducibility and the performance of the sensors. In this work, we develop regenerative nanowire FET biosensors to quantify biomolecular interactions by using low affinity binding systems and supramolecular sensing interface. First, two representative protein binding systems are reported to demonstrate the versatility of the system. By monitoring the binding kinetics (real-time signal during the protein-receptor association/dissociation cycle), the on/off rate constants and equilibrium binding constant for protein receptor interactions can be determined. To our knowledge, these results are the first time experimental demonstration that Si NW-FETs can be used as high-throughput biosensors to quantify protein interactions. Compared to surface plasmon resonance, the advantage of the approach is sensitivity to small molecular weight proteins. In the second approach, Si NW-FETs were functionalized with β-Cyclodextrin (β-CD), to which receptor moieties can be attached with an orthogonal supramolecular linker. Here we demonstrate full recycling using the strongest biomolecular system known, streptavidin (SAv)-biotin. The bound SAv and the linkers can be selectively removed from the surface through competitive desorption with concentrated β-CD, regenerating the sensor for repeated use. An added advantage of β-CD is the possibility of stereoselective sensors, and we demonstrate here the ability to quantify the enantiomeric composition of chiral targets. The demonstrated regenerative electronic biosensors are very attractive both from a device performance and economical point of view, since it permits accurate calibration prior to measurements, and repeated use of the same calibrated device.

About the Speaker

段学欣,男,1979年7月生，天津大学精密仪器与光电子工程学院,研究员、博士生导师，主要从事制造新型的微、纳生物传感器件，并将之应用到生物（化学）分子的检测中。2004年南开大学本科、硕士；2004.09-2005.09 德国马普聚合物研究所 (Max-Planck Institute for Polymer Research, Mainz, Germany) 访问学者；2005.12 - 2010.05 荷兰特温特大学、MESA+ 纳米技术研究所 (University of Twente, MESA+ Institute for Nanotechnology, Enschede, The Netherlands)，博士；2010.05 - 2010.09 清华大学微电子所，访问学者； 2010.09 - 2013.09 美国耶鲁大学电子工程系 (Electrical Engineering, Yale University, New Haven, CT, USA)， 博士后。2013年第五批次青年千人计划入选者（公示中），同年被聘为天津大学精密仪器学院，研究员，博士生导师。