2559-Pos Board B545
Understanding Nanoparticle Drug Delivery from Rotational Dynamics and Behaviors of Functionalized Gold Nanorods on Live Cell Membranes
Yan Gu, Wei Sun, Gufeng Wang, Ning Fang.
Gold nanoparticles with distinctive surface properties share different interactions with the cell membranes, thus show different activities in drug delivery. We used gold nanoparticles themselves as non-blinking, non-photobleaching nanoprobes to study nanoparticle drug delivery. Unlike most single particle tracking experiments that studied the translational motions of particles, we tracked the real-time rotational behaviors of single gold nanorods on live A549 cell membranes. The rotations of differently functionalized gold nanorods are tracked constantly under a Differential Interference Contrast (DIC) Microscope at 200 frames per second. The time series of DIC intensities of the images reflect the rotational dynamics of the gold nanorods. The in-plane and out-of-plane rotations were characterized by calculating the correlation coefficients between bright part DIC intensities and dark part DIC intensities of the gold nanorod. The autocorrelations of the image contrast time-series were calculated, and the rotation characteristic times over time of observation were derived by a non-linear fitting. We found that on one hand, the rotational behaviors of gold nanorod probes are strongly related to the surface charges of the gold nanorods, such as positively charged gold nanorods (PEIs modified, TAT modified, and CTAB stabilized gold nanorods) show a stronger interaction with cell membranes than negative ones (tranferrin modified and carboxylic gold nanorods). On the other hand, specific surface functional groups and availabilities of receptors on cell membranes also contribute to the rotational dynamics of the gold nanorods (such as shown in the differences between transferring modified gold nanorods and carboxylic gold nanorods). This study of nanoparticle rotational diffusion on cell membranes will lead to better understanding of the mechanisms of drug delivery and provide guidance in designing the modification strategies for drug delivery agents under different circumstances.

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Controlled Photo Electro Thermal Generation of Micro Bubble for Manipulation of Cells
Annas Javed, Samarendra Mohanty.
Controlled micro-bubble formation has been an area of growing interest for many researchers due to ubiquitous presence of micro-bubbles in multitude of biological, chemical and physical systems. The important biophysical applications of micro-bubbles include sonoluminescence, flow control in microfluidic channels, contrast enhancement in ultrasound imaging and targeted efficient drug delivery. The earlier techniques for the formation micro bubbles include resistive heating or heat generation using focused laser beam. While resistive heating requires microelectronic pre-fabrication, micro bubble formation by focused laser beam necessitates either selective placement of optically absorbing particles near the pre-decided site(s) or a very high power ultrafast laser beam. Here, we present a novel method of generating micro-bubbles at desired microscopic location by photo-electro-thermal (PET) method, where very low power light is made to shine on a photoconductive coating, made on the ITO-glass substrate, thus forming virtual electrodes. Optimization of the ac frequency and voltage applied between the two ITO-glass substrates led to efficient generation of bubble(s) at the location(s) of shining light beam(s). The power of light beam required to generate micro-bubbles was found to be several orders of magnitude lower than existing laser techniques to form bubbles. The micro-bubbles are found to be very stable up to few hours. Kinetics of bubble formation and performance characteristics of the PET method will be presented. Applications of these micro-bubbles in cellular manipulation including cellular disruption, microinjection and microfluidic actuation will also be covered.

2561-Pos Board B547
Nanoscale Repulsive and Attractive Forces on Transistors - a Study of DNA Interaction with Non Volatile Charge
Krishna Jayant, Joshua B. Phelps, Edwin C. Kan.
Label-free DNA detection by transistors is shown to have a tremendous potential to detect hybridization events and dielectric properties of adsorbed membranes within minutes. We report on an integrated-circuit detection scheme to monitor DNA-DNA interaction with high temporal resolution and novel features of manipulating the adsorbed DNA through long range in situ repulsive electrostatic forces. The floating-gate MOS transistor [1] can also be used as a detector in impedimetric mode by applying independent dc and ac biases from the control gate and the solution, respectively. This technique is shown to accurately measure changes in capacitance at the DNA-transistor interface as the operating point is held constant through the control gate. The output is a strong function of frequency. The transient IV and impedance spectroscopy then probe the surface adsorption, hybridization and molecular make up of the target DNA. In addition by using the property of fowler nordheim (FN) tunneling we can tunnel charges in and out of a floating gate. The stored charge creates an in situ refreshable mechanism at the interface that leads to DNA desorption. Experiments are underway to demonstrate addressable sensor pixel arrays.
[1]. Krishna Jayant, Shantanu R. Rajwade, Lois Pollack and Edwin C.Kan, ''Controlled Adsorption and Desorption on CMOS- Towards a Bi-Directional Bioelectronic Interface'', *Biosensors (2010), World Congress on Biosensors and Bioelectronics, Glasgow, Scotland, UK 26-28th May 2010. P31.081*

2562-Pos Board B548
Vertical Nanopillars for Biointerface: Cell Interactions with Inorganic Nanostructures
Lindsey Hanson, Chong Xie, Xiliang Lin, Yi Cui, Bianxiao Cui.
With unique properties and access to length scales pertinent to biological activities, nanoscale structures and materials stand to make significant contributions to the investigation of cell processes. We investigated cellular interactions with vertically-aligned nanopillars of several materials, and the interface between the cells and said vertical nanopillars. Cells exhibit significantly decreased motility across a nanopillar surface as compared with a flat surface, with average movements over a five day period decreased from 57.8um to 3.0um. Additionally, scanning and transmission electron microscopy analyses show tight seals of around 10 nanometers between the cell membrane and nanopillars, in contrast with the tent-like gaps of 100nm-1um typical between cells and flat surfaces. Not only do cells fail to migrate away from nanopillar surfaces, we have also shown that the nanopillars serve to encourage attachment by cell outgrowths and stimulate the axon growth cone in neurons. As such, patterns of nanopillars serve as effective axon-guiding instruments, and can form the basis of templates for the long-term study of neural networks.

2563-Pos Board B549
Plasmonic Gold-Virus for Targeting, Delivery, and Molecular Imaging
SoonGweon Hong, Mi Yeon Lee, Andrew O. Jackson, Luke P. Lee.
Multifunctional nanoprobes for targeting, delivery and sensing have been highlighted due to their potential in revolutionizing understanding and treatment of diseases. While targeting functionality allows nanoprobes to reach specific, delivery function adding to nanoprobe allows on-demand drug releasing in a required cellular region. A further localization inside cells can be accomplished in sensing function. When nanoprobes are combined with selective optical antenna, it can provide enormous potential for molecular level imaging in living cells through electron absorption and vibration spectroscopic imaging. However, beside a difficulty of combining the two functions, nanoscale-fabrication, single-molecule sensitivity, and practical applications need to be resolved to realize optical antenna on nanoprobe.
Highly organized viral structures are the one of nature's present. Even the simplest viruses have evolved the ability to enter cells, and to co-opt host cellular processes for replication. During the last century, these processes have been intensively studied to understand viral natural functions and to control viral diseases to human health and agriculture. More recently nano/biotechnology attempted to engineer viruses for approaching diagnostic/therapeutic applications.
Here, for multifunctional nanoprobe, we demonstrate another promising paradigm of virus engineering by adding nanospectroscopic antenna on the highly ordered viral capsids. Used representative viruses are a simple but perfectly regular icosahedral, while their detail three dimensional structures increase plasmonic phenomena through thin metal layer imprinted on. An electromagnetic simulation study suggests a plasmonic virus more enhance localized and focused optical field near the particle than similar-sized smooth spheres, guaranteeing localized optical field based sensor applications. Through experiments for SERS and PRET, the viral particles were shown to increase the sensitivity by a factor of ~106, compared to smooth spheres. Therefore, we believe this study increases potential for engineering viruses as resources for powerful research and medical applications involving molecular spectroscopy.

2564-Pos Board B550
Momzymes-Heme Biomimetic Metal Organic Framework Materials
Randy W. Larsen, Carissa M. Vetromile, Lukaz Wojtas, Jason Perman, Michael Zaworotko.
Heme proteins are one of the most widely distributed metalloprotein in nature participating in wide array of chemical processes. The extensive catalytic diversity of heme protein chemistry has made this class of protein an important industrial target but these efforts are hampered by the relative instability of proteins under extreme conditions of temperature, solvents, pH, ionic strength, etc. In order to circumvent these limitations a wide array of biomimetic systems have been developed (with varying success) ranging from heme protein encapsulation into porous matricies (e.g., sol gels) to the so-called 'picket fence' porphyrins containing engineered docking sites on the ring system of discrete