BioMEMS Focus Topic
Room: Hall 3 - Session BM-ThP

BioMEMS Poster Session

BM-ThP1 A Novel Nanoporous Carbon Materials for Adsorption Gibberellins Acid from Solution, *J. Li*, Hunan University, PR China and University of Florida, *J.-T. Xia, J.-H. Zhang,* Hunan University, PR China, ***T. Liang***, University of Florida

Gibberellin acid (GA) is one kind of ubiquitous phytohormones that regulates various developmental processes of the plant growth. Monitoring and controlling the phytohormone is very important to ensure the efficient growth of crops to bring a high yield and quality production in agriculture or horticulture. Since the content of phytohormone in a plant is very low, and easily decomposed by heat, light, and oxygen, it is of considerable interest to the phytohormone research to prepare some specific absorbants for adsorption of phytohormone molecules from the solution. A novel nanoporous carbon with tailored pore structure has been synthesized by dynamic carbonization with silica gel networks as a template, which was formed in sol-gel polycondensation using tetraethoxy silane (TEOS) as a silica precursor and sucrose as a carbon source. The pore structures of this kind of nanoporous carbon can be tunable to a high pore volume of 1.25 cm3/g and a large specific surface of 1744 m2/g, providing an high adsorption capacity about 6.8mg/g to the gibberellin acid (GA) in a solution within 9 h reaction time, and which is over 4~5 times higher than the adsorption of protein and starch in the same solution. It is indicated this nanoporous carbon materials has potential application as a novel absorbant in the separation and purification of GA from the solution for its monitoring assay.

Key words: Nanoporous carbon; Adsorption; Gibberellin acid;

Acknowledgments

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BM-ThP2 Boundary Slip and Nanobubble Study in Micro/Nanofluidics with Atomic Force Microscope, ***Y. Wang***, *B. Bhushan*, The Ohio State University

The boundary condition at the liquid-solid interface in micro/nano scale is an important issue in micro/nanofluidics systems. Recent studies have shown that the fluid velocity near solid surfaces is not equal to the velocity of the solid surface on hydrophobic surfaces, which is called boundary slip. The degree of boundary slip is evaluated by a slip length. Theoretical and experimental studies suggest that at the solid-liquid interface, the presence of nanobubbles is responsible for the breakdown of the no-slip condition. Nanobubbles are long lasting on hydrophobic surfaces, and movement and coalescence of nanobubbles are observed with higher scan loads during imaging with tapping mode AFM.

The slip length can be measured with both contact atomic force microscopy (AFM) and dynamic AFM methods. In the contact AFM method, the slip length is obtained by fitting the measured hydrodynamic force applied to a sphere as a function of separation distance between the sphere and solid surfaces when the sphere approaches the surfaces. In the dynamic AFM method, the amplitude and phase shift data of an oscillating sphere are recorded during approach to sample surfaces at low velocities. These data are then used to get the hydrodynamic damping coefficient to obtain the slip length. Until now, slip length has generally been studied on hydrophobic surfaces with AFM. The boundary slip properties of superhydrophobic surfaces are seldom studied. The impact of surface roughness on the obtained slip lengths also needs to be eliminated for superhydrophobic surfaces. Moreover, because the sphere should disturb the nanobubble during approach to sample surfaces in both the contact and dynamic AFM method, a new technique is needed to evaluate boundary slip. Regarding nanobubbles, the current studies mainly focus on their physical properties. The interaction between nanobubbles and the surfaces supporting them is seldom studied. More importantly, the relationship between nanobubble immobility and surface properties should be studied.

In this study, both contact and dynamic AFM methods have been applied to study the boundary slip on hydrophilic, hydrophobic, and superhydrophobic surfaces. A new AFM based technique is proposed to study boundary slip. Nanobubble movement and coalescence, as well as tip-bubble interaction, are studied in detail. The physical interaction between nanobubbles and the surfaces supporting them is investigated. Moreover, the relationship between nanobubble immobility and surface properties of hydrophobic surface is revealed.

BM-ThP3 Surface Plasmon Resonance Imaging of Carbohydrate Microarray: Kinetics, Surface and Solution Binding Affinity, ***A. Tyagi***, *M. Yan*, Portland State University

Oligosaccharides are increasingly being recognized as important partners in glycan-lectin binding and cellular signaling. Surface plasmon resonance (SPR) is a powerful tool for the real-time study of the specific interactions between biological molecules. We have developed an efficient surface coupling chemistry to probe carbohydrate-lectin interactions in an array format using SPR imaging. The coupling agent, a thiol-functionalized perfluorophenyl azide, PFPA-MUTEG, allows the covalent attachment of carbohydrates to gold surface by way of CH insertion reactions. The SPR chips were modified with mixed SAMs of PFPA-MUTEG and MDEG before the carbohydrate ligands were arrayed and immobilized. The carbohydrate array was composed of α-1,3-α-1,6-D -mannotriose, α-1,2-D -mannobiose, D -mannose, D -glucose and D -galactose, and the binding studies were carried out using Concanavalin A, a plant lectin that exhibits mannose-binding properties. The kinetic equilibrium constant (KA), adsorption coefficient (KADS) and solution equilibrium constant (KD) were obtained for each carbohydrate at different mixed SAM composition. The SAM containing 10% MDEG showed the highest sensitivity and the least non-specific adsorption. The KADS values for mannotriose, mannobiose and mannose were measured to be 10.3 ± 1.1 x 106, 7.6 ± 1.0 x 106, 1.3 ± 1.0 x 106M-1, respectively.

BM-ThP4 Chemical and Morphological Properties of Amino-Silane Coated Surfaces for DNA Purification, *L. Marocchi, L. Lunelli, L. Pasquardini, C. Potrich, L.E. Vanzetti,* FBK-CMM, Italy, *G. Guella,* University of Trento, Italy, *C. Pederzolli,* FBK-CMM, Italy, ***M. Anderle***, Provincia Autonoma di Trento, Italy

DNA purification and PCR amplification are a requirement for most genetic analysis. Combining these processes in a single micro device minimizes sample loss and contamination problems as well and reduces time and costs of analysis. Different strategies are available to perform DNA extraction on a chip. Here we exploited amino-coated silicon and pyrex surfaces as a tool for specific binding of DNA through the electrostatic interaction between amino groups and nucleic acids. Amino groups have been introduced on the surfaces via silanization carried out in wet condition [1] using three silanes carrying a different number of amino groups and different alkoxy groups ((3-Aminopropyl)triethoxysilane (APTES), (3-Aminopropyl)trimethoxysilane (APTMS) and (3-[2-(2-Aminoethylamino)ethylamino]propyl-trimethoxysilane (AEEA)). The influence of different silanization conditions on surface properties, such as homogeneity and thickness of the silane layer, was also studied by changing solvents, concentration of silane solution and reaction temperature. The kinetic of hydrolysis of the alkoxy groups followed by oligomerization of aminosilanes was characterized by NMR measurements. Amino-coated surfaces were characterized by AFM, XPS and absorption spectroscopy to define their chemical and morphological properties. Multi-amino silane were found less prone to form uniform and tiny layers than mono-amino silanes, resulting less suitable for successive PCR amplification.

Finally, we analyzed the ability of treated surfaces to selectively adsorb/desorb genomic DNA with the aim to purify DNA from unwanted cellular components. Preliminary results suggest this strategy as very promising, permitting to obtain a considerable yield of purified DNA in short time.

[1] Fiorilli, S.; Rivolo, P.; Descrovi, E.; Ricciardi, C.; Pasquardini, L.; Lunelli, L.; Vanzetti, L.; Pederzolli, C.; Onida, B. & Garrone, E. (2008), *Journal of Colloid and Interface Science* **321**, 235-241.

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