The Department of Mechanical Engineering/College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar

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Lecture Title: Nano-characterization and Nano-patterning for Graphene Device

Wednesday, September 12, 2012, 1:00PM, Room 173 Light Engineering

Abstract

Many studies are on progress to modify the band structure and enhance the electronic properties of graphene by confining the conducting path, to fabricate graphene-based nano-device. Most scanning probe lithography (SPL) patternings of graphite or graphene have been performed in air, because water meniscus formed between tip and sample mediates the etching reaction. This water meniscus, however, may prohibit uniform patterning due to its strong surface tension or large contact angle on surfaces. To improve the patterning condition, our experiment was performed in a chamber where gas environment was controlled with particular gases. The line patterning on thin graphite layer was performed by using SPL technique by controlling pressure of gases such as H_2O, O_2, isopropanol, methanol, and air. Among these gases, methanol was the best choice for narrow line patterning with nanometer scale. The methanol includes oxygen atoms which gives rise to a required oxidation. Due to low surface tension and highly adsorptive behavior, the methanol provides advantages for narrow line width and high speed etching condition. While the large surface tension of water degrades pattern quality in etching, methanol with low surface tension and high solubility on graphene provides a suitable environment for the nanometer scale patterning. In methanol environment, the line patterning with 3 nm line width was achieved. A graphene cellular array on an insulating SiO_2 layer was fabricated by SPL. The graphene layer was oxidized by an electric field which was applied between the cantilever tip and Si substrate without any electrode directly connected to the graphene layer. When the bias voltage was applied on a cell of patterned graphene through the cantilever tip, charge was accumulated on the cell and preserved for a long time without decay. The accumulated charge and the surface potential were measured by an electrostatic force microscope. The charge retention was measured as a function of time, and the decay time constant was estimated to be ~70 min.

Biography

Yongho Seo is an associate professor in Nano Engineering department at Sejong University, Korea. His research interest is on nano materials like graphene and ZnO, and instrumentation based on scanning probe microscopy. He received his BS degree from Sogang University, Korea (1993) and MS degree from Seoul National University, Korea (1995), and Ph.D. degree in Physics department from Seoul University, Korea (2000), followed by postdoctoral research associate positions in Seoul National University (2000-2002), University of Virginia (2002-2004), and Northwestern University (2004-2005). He was a research staff in Samsung Advanced Institute of Technology (2005-2006) where he developed a multi-probe type scanning probe microscope.

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