

EE 298-12
Solid State Technology and Devices Seminar
Course Control Number: 25681
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1-2 pm in the Hogan Room
(521 Cory)

Molecular-Scale Transistors and Polymer-Based Memory Devices

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Idea of utilizing individual molecules as the electronic components in future ultrahigh-density electronic devices has generated tremendous attention. Obtaining transistor action from molecular orbital control has been the outstanding challenge of the field of molecular electronics nearly since its inception. In this talk, I will explain a direct electrostatic modulation of orbitals in a molecular transistor configuration, with both effective gate control and enhanced resonant coupling of the orbitals to the source and drain electrodes [1]. I will also explain recently developed understanding on the electrical transport characteristics through various types of molecular junctions on flat or flexible substrates [2]. In the second part of this talk, I will present a summary on general characteristics of the materials, device structures, and switching mechanisms used in organic resistive non-volatile memory devices. Strategies for performance enhancement, integration, and advanced architectures in these devices will be presented [3]. And, if time is allowed, I will briefly discuss other research results on nanoscale logic circuits and graphene-electrode optoelectronic devices [4].

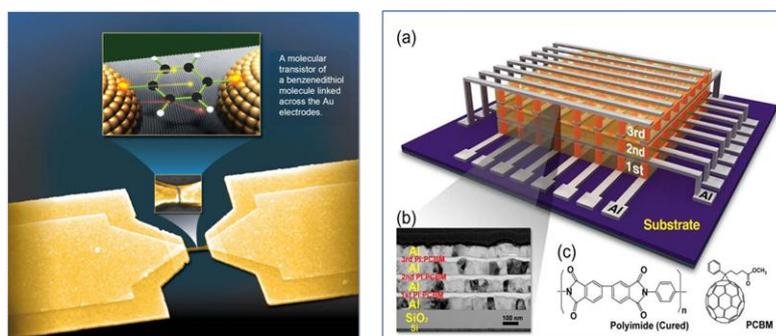


Figure. (Left) SEM images and schematic of a molecular transistor. (Right) Cross-sectional TEM image and schematic of 3-dimensionally stacked organic resistive memory devices.

References:

- [1] Nature 462, 1039 (2009), Adv. Mater. 23, 1583 (2011)-review.
- [2] Nature Nanotechnology 7, 438 (2012), J. Mater. Chem. 21, 18117 (2011)-review, Adv. Mater. 23, 755 (2011)
- [3] Adv. Funct. Mater. 21, 2806 (2011)-review, Adv. Mater. 23, 2104 (2011), ACS Nano, 5, 5995 (2011), Adv. Mater. 22, 5048 (2010), Adv. Mater. 22, 3071 (2010), Adv. Mater. 22, 1228 (2010), Adv. Mater. 21, 2497 (2009).
- [4] Nanotechnology, 23, 112001 (2012)-review, Adv. Mater. 23, 100 (2011), Adv. Mater. 21, 2156 (2009), Nano Lett. 8, 950 (2008).

Takhee Lee's biography



Takhee Lee is currently an associate professor in the Department of Physics and Astronomy, Seoul National University, Seoul, Korea. He received his B.S. (1992) and M.S. (1994) in Physics from Seoul National University. He obtained his Ph.D. (2000) in Physics from Purdue University, USA. Then, he worked as a postdoctoral associate at Yale University, USA until 2004. He was a faculty member in the Department of Materials Science and Engineering, Gwangju Institute of Science and Technology, Korea from 2004 until 2011. His current research interests are molecular electronics, polymer memory devices, and graphene-electrode optoelectronic devices. He has edited two books and contributed 10 book chapters, 10 review articles, and 160 journal articles. He was awarded the *Korean Scientist of the Month Award* (2010 June), *Prime Minister Award* (2010 April), *Minister of Education, Science and Technology Award* (2008 April, 2010 August), and *Nano-Korea Researcher Award* (2007 August). He is serving as an editorial board member in *Nanotechnology*. And he is the director of the Korean National Creative Research Initiative Center for Molecular Nanoelectronics since 2012.