Center for Artificial Low D Electronic Systems

2024 IBS-CALDES Seminar

- ✓ **Date & Time** 02:00 PM , May 17(Fri), 2024
- ✓ **Venue:** Room #105, IBS POSTECH campus bldg.
- ✓ **Speaker & Title**

  02:00PM Prof. Masaki Kawano (Department of Chemistry, School of Science, Tokyo Institute of Technology)

  "Nonvolatile Organic Memory: Structure-Function Relationships"

Organized by: Prof. Han Woong YEOM (yeom@postech.re.kr, 054-260-9000)

- **02:00PM~**

“Nonvolatile Organic Memory: Structure-Function Relationships”

Masaki Kawano
Department of Chemistry, School of Science, Tokyo Institute of Technology

Over the last decade, resistive switching memory devices (ReRAM) have been intensively studied in not only academia but also in the industrial field because of expectations for replacing ordinary memory devices owing to their simple architecture, scalability, CMOS compatibility, and fast operation. However, the development of ReRAM faces the limit of commercialization because of the unstable switching mechanism ascribed to metallic filament formation through the defects in the active layer which was hardly controlled. Although various switching mechanisms were proposed, they still remain ambiguous because of lack of the detailed mechanistic study. To overcome these difficulties, we need a paradigm shift to utilize molecular properties themselves. Herein, we report general guidelines for designing resistive switching memory devices using redox-active organic molecules, highlighting the importance of redox-activity and molecular arrangement. Redox-active organic molecule, 2,5,8-tri(4-pyridyl)1,3-diazaphenalene[1,2], showed non-volatile bistable resistance states with high on-off ratio, retention, and endurance only when the molecular orientation was anisotropic. Control experiments using redox-active/redox-inert organic molecules with isotropic/anisotropic molecular orientations implied that the formation of conductive oxidized $\pi-\pi$stacking layers from non-conductive neutral $\pi-\pi$ stacking layers is responsible for the resistive switching phenomena. Our findings will give a comprehensive understanding of electron transport in organic solid materials based on the effects of redox-activity and molecular arrangement.

(1) J. Y. Koo, Y. Yakiyama, J. Kim, Y. Morita, M. Kawano, Chem. Lett., 44, 1131 (2015).
(2) J. Y. Koo, Y. Yakiyama, G. R. Lee, J. Lee, H. C. Choi, Y. Morita, M. Kawano, J. Am. Chem. Soc., 136, 1776 (2016).