Center for Artificial Low D Electronic Systems

2023 IBS-CALDES Seminar

✓ **Date & Time:** **May 22 (Mon), 2023, 4:00 PM**

✓ **Venue:** **Room #104 - Auditorium**
IBS POSTECH Campus(New building)

✓ **Speaker & Title**

Prof. Dongseok Suh (Ewha Womans Univ.)

2D material transistors :
Common interest between physics and the semiconductor industry

Organized by Dr. Jhin Hwan Lee (jhinhwan@ibs.re.kr, 054-279-9894)

- **04:00 PM~**

2D material transistors : Common interest Between physics and the semiconductor industry

Dongseok Suh

Department of Physics, Ewha Womans University, Seoul 03760, Republic of Korea

Transistors are essential components in electronic devices, and the semiconductor industry is constantly seeking ways to scale down transistors to achieve higher performance and power efficiency. However, traditional transistor technologies face challenges in further scaling due to physical limitations. 2D materials, such as graphene and transition metal dichalcogenides (TMDs), offer unique properties that make them promising candidates for next-generation transistors. They can be combined to form heterostructures, enabling the creation of complex electronic devices with tailored properties. Integrating 2D materials into transistor designs is seen as a potential solution to the scaling challenge.

Transistors provide an excellent platform for studying 2D materials from a physics perspective. By adjusting the gate voltage, the carrier concentration in the channel region of the transistor can be controlled, providing a means to examine the electronic properties and explore the unique phenomena exhibited by 2D materials as well as their heterostructures. Additionally, 2D material itself is the surface of the transistor channel that is highly sensitive to the surrounding conditions. Such sensitivity allows researchers to study the interaction between 2D materials and their environment.

In this presentation, we will discuss the experimental approaches from a physics viewpoint involving 2D material transistors in contact with functional materials exhibiting ferroelectricity, ferromagnetism, or other quantum behaviors, which gives a novel tool to detect the phase transition of functional materials. Furthermore, we will showcase our endeavors to address the industrial-level interest in developing ferroelectric-FETs and negative-capacitance FETs using 2D materials.

References

[1] “Charge carrier modulation in graphene on ferroelectric single-crystal substrates”, NPG Asia Materials 14 (1), 58 (2022)

[2] “Distinctive Photo-Induced Memory Effect in Heterostructure of 2D Van Der Waals Materials and Lanthanum Aluminate”, Advanced Optical Materials 10 (16), 2200124 (2022).

[3] “Two-dimensional ferromagnetism detected by proximity-coupled quantum Hall effect of graphene”, npj Quantum Materials 7 (1), 27 (2022)

[4] “Quantum Conductance Probing of Oxygen Vacancies in SrTiO3 Epitaxial Thin Film using Graphene”, Advanced Materials 29 (18), 1700071 (2017)

[5] “Voltage Scaling of Graphene Device on SrTiO3 Epitaxial Thin Film”, Nano Letters 16 (3), 1754-1759 (2016)