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날짜 및 시간 : 2025.06.27. 16:00 ~ 17:00

강연장소 : 인하대학교 5E207B

강연주제 : Designing oxide heterostructures for advanced electronic and energy applications

강연내용 : Atomic-level modulation in oxide heterostructures enables precise control over electronic phases, such as metal-insulator transitions and interfacial conductivity. This approach is critical for tailoring emergent functionalities and enhancing device performance in next-generation electronic and energy systems. In this presentation, I introduce novel strategies to manipulate electronic properties through atomic-scale modulation in oxide heterostructures. First, I present that iso-valent Ti doping in supercooled VO<sub>2</sub> epitaxial films induces a metal-insulator transition (MIT) with minimal hysteresis, without altering the unit-cell volume or crystal symmetry [1]. The Ti dopants locally disrupt the long-range V-V pair ordering, forming nanoscale V-V dimer domains. Remarkably, these local dimers persist even above the transition temperature ( $T_M$ ), enabling a zero-strain electronic MIT. This mechanism significantly enhances switching speed and endurance, which are crucial for electronic device operation. In the second part, I present a new strategy to spatially confine oxygen vacancies at oxide homo-interfaces [2]. By sequentially growing TiO<sub>2</sub> films under low pressure and temperature on high-quality anatase TiO<sub>2</sub> epitaxial layers, a two-dimensional (2D) conducting interface is formed. This interface exhibits metallic behavior with high carrier density and electron mobility. Moreover, the 2D layer facilitates the formation of in-gap states, which enhance photocarrier lifetime, light absorption, and overall photocatalytic activity. These findings highlight the potential of atomic-level engineering in oxide heterostructures to unlock novel electronic functionalities for future high-performance electronic and energy devices.

[1] Y. Park *et al.*, *Adv. Mater.* **27**, 2413546 (2025)

[2] M. Yoon\*, Y. Park\* *et al.*, *Adv. Mater.* **37**, 2413062 (2025)

Host: 정 중훈 교수