

Seminar at Ajou University

# Two-Dimensional Transport Phenomena at Heterointerfaces

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## Abstract

Over the past decade, the discovery of a two-dimensional electron gas (2DEG) at the  $\text{LaAlO}_3/\text{SrTiO}_3$  interface resulted in the observation of remarkable properties not present in conventional semiconductor heterostructures, and so become a focal point for device applications. Its counterpart, the two-dimensional hole gas (2DHG), is expected to complement the 2DEG. However, although the 2DEG has been widely observed, the 2DHG has proved elusive. In this seminar, I will introduce a highly-mobile 2DHG in epitaxially-grown  $\text{SrTiO}_3/\text{LaAlO}_3/\text{SrTiO}_3$  heterostructures. By electrical transport measurements and in-line electron holography, I provide direct evidences of a 2DHG that coexists with a 2DEG at complementary heterointerfaces in the same structure. We found that the precise control of interfacial atomic structure and the removal of point defects are prerequisites to realizing 2DHG at oxide heterointerfaces. As another example of important interfacial phenomena, I will introduce the random charge fluctuation at graphene interfaces. The charge trapping behavior of interfacial defects are observed by a new technology, noise spectral imaging, that can visualize and even quantify the distribution of interfacial charge trapping sites. Lastly, I will conclude this seminar by discussing about emergent electronic phenomena in hybrid nanostructures. The in-depth study on the interfacial phenomena will allow us to explore exciting new physics in various hybrid nanostructures and also develop advanced electronic device applications.