**Exciton Phase Transition in Two-Dimensional Semiconductors**

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Excitons consist of the foundation for all kinds of optoelectronic devices. Hence the understanding and manipulation of excitons is critical for device development. One of the most intriguing features of excitons is exciton phase transition. Much like atoms or molecules, which may form different physical states including gas, liquid, and solid, excitons may exist in different phases under appropriate conditions. However, the understanding for exciton phase transition has remained limited. In this talk, I will demonstrate that 2D semiconductors such as MoS2, WS2, MoSe2, and WSe2 provide an ideal platform for the fundamental and applied studies of exciton phase transition. We have studied two phase transitions of excitons, exciton Mott transitions that drive a crossover of gas-like free excitons (FEs) to an ensemble of ionized excitons, *i.e.* electron hole plasma (EHP) and a gas-liquid phase transition to form a liquid-like phase, *i.e.* electron-hole liquid (EHL). We elucidate much new fundamental understanding of the exciton phase transition, such as the criteria of exciton Mott transition, effect of the exciton phase transition on the mobility and dynamics of charge carriers, and thermodynamics involved in the phase transition process. We have also demonstrated that the phase transition of excitons, in particular the formation of EHL, which has always been observed at cryogenic temperature previously, occurs at room-temperature in 2D semiconductors due to the strong exciton binding energy of the materials. The room-temperature exciton phase transition provide new opportunities for the studies of fundamental many-body quantum physics, and also opens up the door for the utilization of EHL in the development of useful photonic devices with novel functionalities.

**Biography**

Linyou Cao is an associate professor in Department of Materials and Science and Engineering with affiliation in Electrical and Computer Engineering and Physics Departments at North Carolina State University (NCSU). He obtained a PhD degree from Stanford University in 2010 and held a Miller Research Fellowship at UC Berkeley prior to joining the faculty of NCSU in 2011. He has published 70+ peer reviewed papers in highly respected journals with 9600+ citations and a H-index of 39 (Google Scholar). He pioneers the controlled scalable synthesis, photonics, and catalysis of two-dimensional semiconductors, and has obtained numerous prestigious awards such as CAREER AWARD from National Science Foundation and Young Investigator award from Army Research Office. He is also dedicated to commercializing scientific research and has founded a start-up 2Dlayer to supply wafer-scale 2D semiconductors.