Next-generation Nano-devices Enabled by Tailoring the van der Waals Interactions

Abstract: Two-dimensional (2D) van der Waals materials have become important building blocks for future electronic, photonic, and phononic devices. The relatively weak van der Waals interactions can be easily modulated/tailored by various ways (electrically, mechanically, optically, etc), which can enable lots of interesting tunable devices. In this talk, I would like to talk about next-generation nano-devices enabled by tailoring the van der Waals interactions. I will highlight our recent research achievements - the demonstration of atomically thin micro-lens using 2D MoS$_2$, the thinnest optical component around the world, which are based on the strong elastic light-matter interactions in high-index 2D materials. The unique and large tunability of the refractive index by electric field in layered MoS$_2$ could enable various applications in electrically tunable atomically thin optical components, such as micro-lenses with electrically tunable focal lengths, electrical tunable phase shifters with ultra-high accuracy, which cannot be realized by conventional bulk solids. Next, I will present how we utilize acoustic waves from nano-electro-mechanical system (NEMS) platforms to manipulate electro-optic properties of the low-dimensional materials and their hybrids, which allows us to explore the significant science in quantum limit and to develop new types of sensors, actuators and other opto-electro-mechanical devices. Finally, I will briefly talk about my vision and discuss our future directions.

Biography: Dr. Yuerui (Larry) Lu is an Associate Professor at Australian National University (ANU). He received his Ph.D. degree from Cornell University, the school of Electrical and Computer Engineering. He holds a B.S. degree in Applied Physics from University of Science and Technology of China. He was the recipient of Discovery Early Career Research Award (DECRA) from Australian Research Council (ARC) in 2014. Currently, he is leading the Nano-Electro-Mechanical System (NEMS) Lab at the ANU. His research interests include MEMS/NEMS sensors and actuators, nano-manufacturing technologies, renewable energy harvesting, biomedical novel devices, 2D materials and devices.
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