Electrically tunable 2D devices with exceptional functions

Gwan-Hyoung Lee [1]
[1]*Yonsei University , Korea, Republic of*

Two-dimensional (2D) materials have brought a great deal of excitement to nanoscience community with their attractive and unique properties. Such excellent characteristics triggered highly active researches on 2D material-based electronic devices. New physics observed only in 2D semiconductors allow for development of new-concept devices by using their valleys, tunneling effect, photoluminescence, and optical responsivity. Recently, van der Waals heterostructures (vdWH) have been achieved by putting these 2D materials onto another, in the similar way to build Lego blocks. Assembly of 2D blocks for van der Waals heterostructures provide a big playground for engineers and physicists to investigate unprecedented properties of 2D materials and fabricate multi-functional electronic devices. This enables us to investigate intrinsic physical properties of atomically-sharp heterostructure interfaces and fabricate high performance optoelectronic devices for advanced applications. However, there are several obstacles to be overcome for practical application of 2D materials and their devices. In this talk, fundamental properties of various 2D materials will be introduced, including growth techniques for graphene and 2D semiconductors. Then, I will talk about high performance electronic/optoelectronic devices of vdWH, such as transistors, memories, and solar cells. By utilizing unique band structures of 2D materials and tunable work function of graphene, exceptional functions of the van der Waals heterostructure devices were achieved, enabling us to fabricate electrically tunable optoelectronic devices. For high integrated 2D devices, we also developed fluorographene electrodes for vertically stacked graphene devices. Our results show great potential of 2D materials and their van der Waals heterostructures for future electronics.