Hoshi LAB.

［Development of next-generation optoelectronic devices with van der Waals heterostructures］

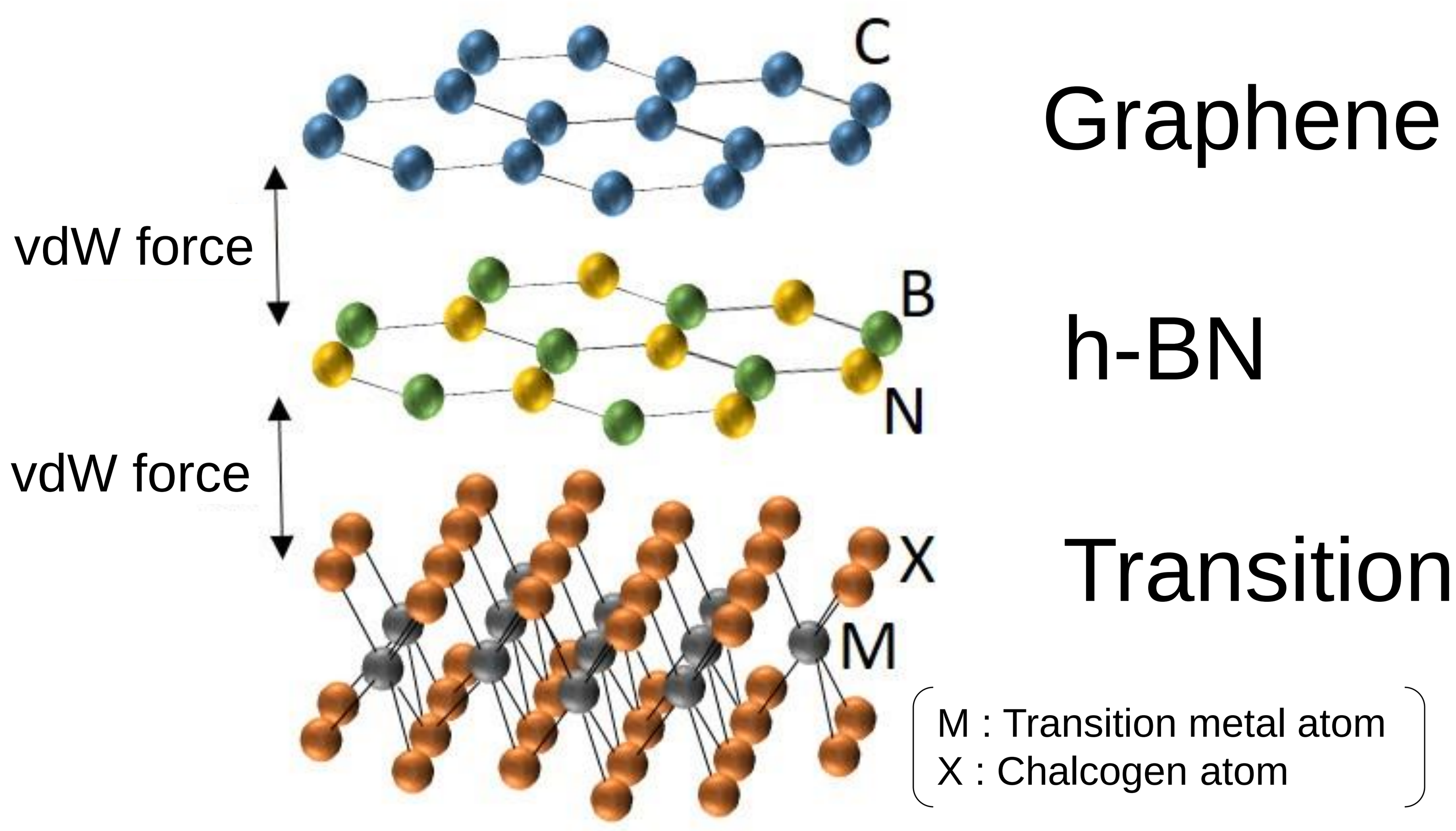
Integrated Research Center for Sustainable Energy and Materials

http://qhe.iis.u-tokyo.ac.jp/

Solid-state Quantum Functional Devices

Department of Materials Engineering

We study the fundamental optical properties and device applications of van der Waals (vdW) heterostructures, which consist of two-dimensional atomic crystals bound to each other with vdW forces.



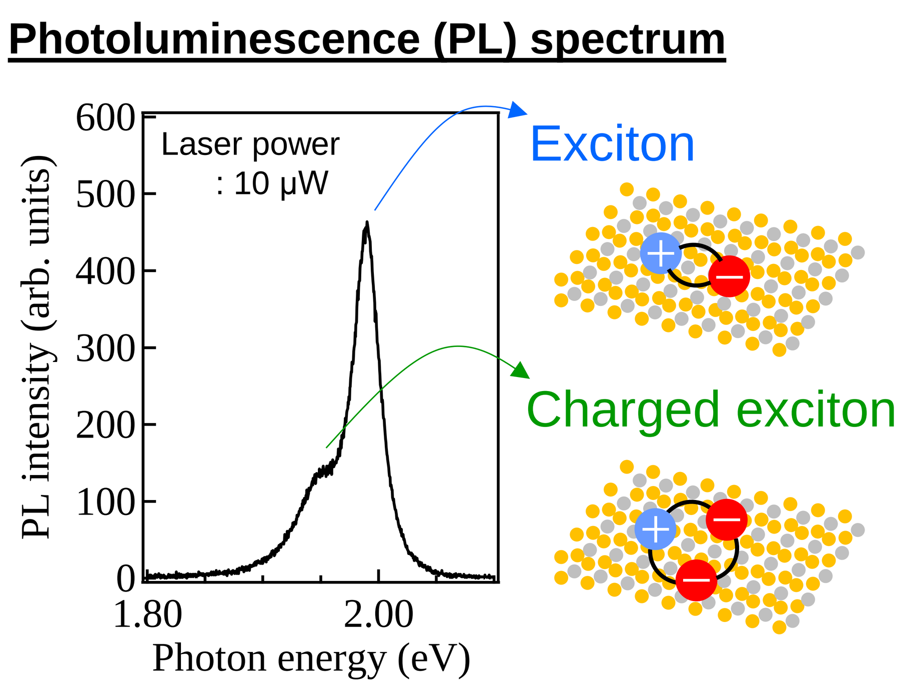
Graphene ・・・ Massless Dirac fermion

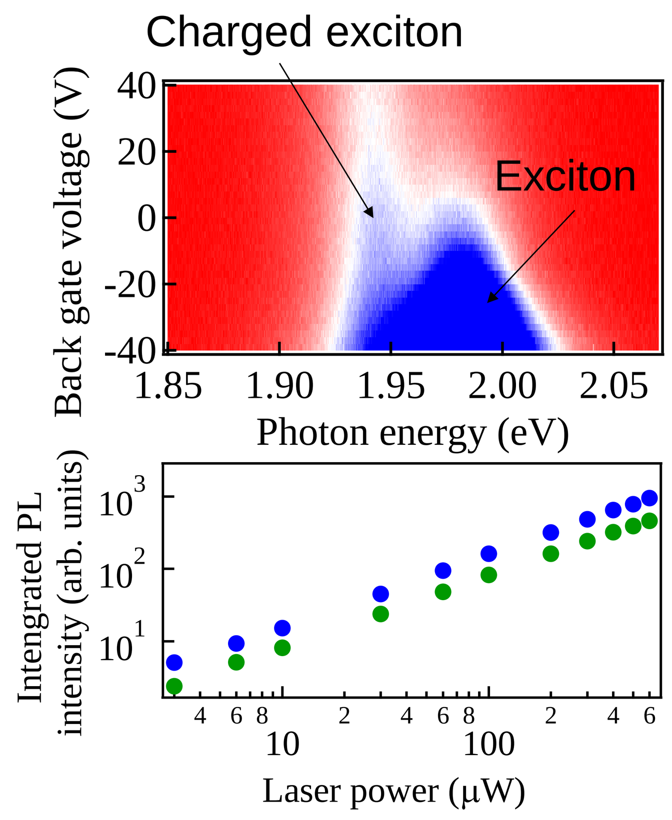
h-BN ・・・ 2D dielectric material

Transition metal dichalcogenides (TMD) ・・・ 2D-layered semiconductors

Fundamental optical properties of van der Waals heterostructures

Optical properties of TMD depend strongly on the structural parameters such as the layer number and surrounding materials. We investigate fundamental optical properties for various TMD monolayers encapsulated by h-BN. We demonstrated that the photoluminescence peak intensity based on exciton emission was very large even under strong photoexcitation.





Twist-controlled transition metal dichalcogenide multilayers

Tungsten disulfide (WS_2) multilayer is a semiconductor with an indirect band-gap. We found that the efficiency of light emission for the twist-controlled WS_2 multilayers is higher than that for a WS_2 monolayer with a direct band-gap. We try to develop light emitting diodes with ultra-low power consumption by utilizing the twist-controlled WS_2 multilayers.