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Number of layer dependent direct optical transition from monolayer to pentalayer in synthesized large area $MoSe_2$

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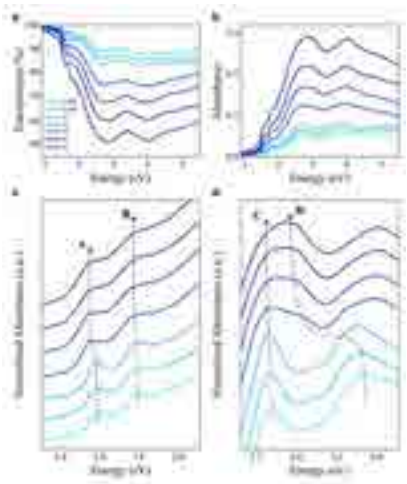
Two-dimensional transition metal dichalcogenides (TMDs) have attracted great interest for applications in optoelectronic device. We studied the optical properties of the large area $MoSe_2$ thin film on c-axis sapphire (0001) substrate grown by molecular beam epitaxy (MBE). Photoluminescence (PL), Raman, X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS) were measured to evaluate the film quality. We obtained the optical absorption spectra of mono-, bi- and tri-layer $MoSe_2$ and observed optical critical point which is corresponded to the direct transition at Γ-point of the Brillouin zone (BZ) at ~3 eV. Increasing the number of layer, the intensity of the absorption peak at Γ-point was increased and its position was shifted. The changes in peak at Γ-point are caused by the band structure depending on the number of layer, resulting in the modulation of the joint density of state (JDOS). Since the geometrical band shape of conduction band and valance band are similar around Γ-point for few layer $MoSe_2$, both Van Hove singularities (VHS) and band nesting contribute to strong absorption peak. Using 3eV optical pump, we can selectively excite the $MoSe_2$ by choosing suitable number of layers. The modulation of band structure and strong photon-electron interaction of 2D material would be widely applied to photonic and optoelectronic devices.



Biography

Jae-Hun Jeong has expertise in the properties of two-dimensional materials such as MoS2 and MoSe2. His large-area growth technology and in-depth research have laid the foundation for 2D materials to be used in next-generation applications. His research approach, which focuses on deep physics and his large-area growth techniques are expected to make a valuable contribution to the development of new-level devices

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