Optical properties of atomic layer materials

In this presentation, we overview our recent work of Raman and optical properties of twisted bilayer graphene (tBLG) [1], and transition metal dichalcogenides (TMD) [2-4]. Raman spectroscopyhas been widely used for characterizing the number of atomic layers, twisting angle in tBLG [1] and electronic structure through the resonance Raman processes. In two dimensional (2D) materials, the joint density of states (JDOS) is singular logarithmically as a function of laser excitation energy (E_L). Thus we expect a significant enhancement of Raman intensity for particular E_L. In the hexagonal lattice, since the electronic energy dispersion becomes flat in the *k* space near the M point (center of hexagonal edge of the Brillouin zone), most of the singular JDOScorrespond to the optical transitions excited near the M point. Then the photo-excited electron near the M point can be scattered from one M point to other M points in the Brillouin zone by electron-phonon interaction [2]. This situation tells us that second order Raman processes with so-called double resonance Raman processes occurs by emitting the M point phonon [3]. We assigned many weak Raman spectra of TMD materials to the M point phonon modes by double resonance Raman spectra, by using ultra-violet light source (Fig). [3,4]

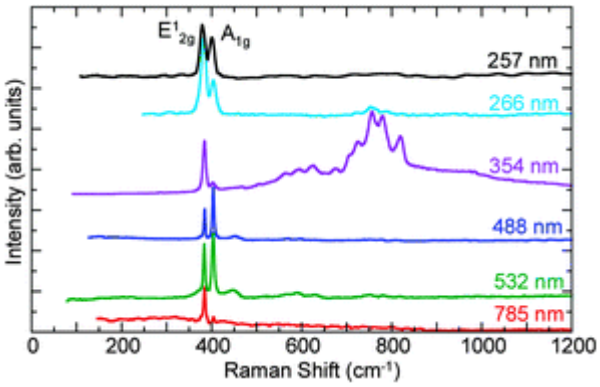

Fig: Anomalous Raman spectra of MoS_2 at 354nm [3].

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