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Probing two dimensional (2D) semiconductors by employing nonliner optical microspectroscopy

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After the incredible success of graphene, two-dimensional (2D) semiconductors have become the focus of much theoretical and experimental investigation. Transition metal dichalcogenides (TMDC), one such class of layered 2D materials, become the focus of fundamental research and technological applications due to their unique crystal structures, versatile electronic, optical, mechanical and chemical properties. 2D TMDCs are usually denoted by MX_2 , where M represents a transition metal(Mo, W, Ti etc.) and X represents the chalcogen (S, Se, and Te). This type of semiconductor have also attracted a great deal of attention in that they exhibit novel and intriguing properties with potentials application in field of transistors, optoelectronic devices, topological insulators and biosensor. For example, monolayer MoS_2 has recently been shown as an efficient material for low power field effect transistor, phototransistor and biosensor. In this talk, we will present out recent study on the nonlinear optical and electronic properties of such materials. We demonstrate an effective microspectroscopy technique by tracing the dispersion of second order nonlinear susceptibility $\chi^{(2)}$ in a single atomic layer of tungsten diselenide (WSe_2). Ultra-broadband continuum pulses served as the fundamental beam while its second harmonic spectrum in visible and ultraviolet (UV) was detected and analyzed with better than 0.3 nm spectral resolution (<2 meV). The obtained results allowed us to estimate peak second order nonlinearity values that are found to be within 89-104 pm/V range. The resonant enhancement of the nonlinearity and peak broadening are governed by higher density of states transitions within the split-off band of the monolayer semiconductor. Sub-structure in the $\chi^{(2)}$ dispersion shows a contribution to the nonlinearity due to exciton transitions with exciton binding energy of 0.181±0.001 meV.

Biography

Mohammad Mokim is a PhD Student in the Department of Physics at University of Rhode Island supervised by Feruz Ganikhanov. His expected graduation date is May'2018. He received his BS degree in Physics from University of Dhaka and completed his Master's degree in Physics from Kent State University,USA.

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