TIFR Centre for Interdisciplinary Sciences
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Seminar

Two Dimensional Materials and Their Heterostructures

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Two-dimensional (2D) materials such as graphene, hexagonal boron nitrides (h-BN), transition metal dichalcogenides (TMDs), and so on have attracted considerable attention in the past few years because of their novel properties and versatile potential applications. These 2D layers can be integrated into a monolayer (lateral 2D heterostructure) or a multilayer stack (van der Waals 2D heterostructure), resulting artificial 2D structures with intriguing physical properties completely different from their individual components. While stacking different 2D crystals together, charge redistribution might occur between the neighboring crystals that facilitate novel electro-optical phenomena in these hybrid systems.

In this talk, I will present a new optical phenomenon i.e. interlayer excitons (i.e., bound electron-hole pairs assigned to different layers) observed at the heterojunctions in van der Waals heterostructures consisting of atomic thin $MoSe_2$ and WSe_2 layers. Interestingly, we found that interlayer excitons are highly susceptible to the strength of interlayer coupling between the two layers i.e. the photoluminescence (PL) intensity of the interlayer excitons is enhanced at coherently stacked angles of 0° and 60° (owing to strong interlayer coupling) but disappears at incoherent intermediate angles due to weak coupling. Moreover, by the incorporation of a hexagonal boron nitride monolayer between $MoSe_2$ and WSe_2, it is observed that the interlayer coupling becomes insignificant and PL of interlayer excitons disappears completely irrespective of the twist angle. This finding explores new optical phenomena concealed in these heterostructures, which paves a step further towards application of vdW HS in optoelectronic devices.

Finally, several aspects of this growing research area including synthetic strategy of heterostructure fabrication, new technological opportunities towards optoelectronics and nanoelectronics will be discussed.

Monday, Nov 28th 2016

4:00 PM (Tea/Coffee at 3:45 PM)

Seminar Hall, TCIS