Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Tuning Monolayers of MoS_2 for Electronics and Opto-Spintronics via Doping and Heterostructuring

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Two-dimensional transition-metal dichalcogenide (TMDC) semiconductors like MoS_2 hold promise for next-gen devices, yet face hurdles in industrial applications due to imperfections of wafer-scale deposition techniques and contact impedance issues. On the other hand, monolayer MoS_2's high Spin-Orbit Coupling (SOC) and inherent broken spatial inversion symmetry hold promise for valleytronics, while magnetic dopants bringing long range magnetic ordering can introduce time-reversal symmetry breaking too. Our research was trying to address some such problems by optimising the growth conditions and controlling dopant concentrations. We could successfully grew large-scale monolayer MoS_2 (5mm*5mm) using a modified CVD setup, exhibiting enhanced electron transfer characteristics. We successfully tailored the electronic properties of monolayer MoS_2 and demonstrated an approach where we addressed the high Schottky barrier height (SBH) of conventional metallic contact Au/MoS_2 (~ 215 meV) junction by introducing an interfacial layer of degenerately-doped monolayer of MoS_2 (~9 atomic% V doped MoS_2, V-MoS_2), thereby reducing the SBH to (~ 99 meV). By doping V and Se into the MoS_2 lattice, we could demonstrate a system (V-MoSSe) having both valley shift and bandgap tunability. Furthermore, we demonstrated that V-doped MoS_2 functions as a magnetic spin Hall material, highlighting its potential for spin torque device applications. Potential of MoS_2 in conjunction with other protective layers such as fluorographene in strain dependent photodetector applications is also attempted, and will be briefly discussed.

Monday, Jul 7th 2025

11:30 Hrs (Tea / Coffee 11:15 Hrs)

Auditorium, TIFRH