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FOR BASIC SCIENCES
Block JD, Sector III, Salt Lake, Kolkata 700 106

DEPARTMENTAL SEMINAR

Condensed Matter and Materials Physics

10th August'2022 **11.30 AM** **ONLINE/ FERMION**

SPEAKER

Dr. M. Venkata Kamalakar,
Associate Professor & Team Leader
Quantum Material Devices Group
Department of Physics and Astronomy, Uppsala University

TITLE OF THE TALK

TWO-DIMENSIONAL SPIN CIRCUITS: EXPLORING INTERFACES AND SUBSTRATES FOR EFFICIENT SPIN CURRENTS AND NOVEL DEVICES

ABSTRACT

Spintronics (spin electronics) is a promising field with huge potential to revolutionize the IT industry and next-generation electronic applications. The nearly past three decades of research in spin currents (spin-polarized electric currents) has led to a colossal expansion of computer memory storage capacity through the giant magnetoresistance effect (Nobel Prize in Physics 2007). Beyond this groundbreaking advancement, spin currents exhibit outstanding prospects for ultralow power and faster electronics through memory-logic integration. For exploring such prospects, the new class of two-dimensional (2D) materials that are atomically thin crystals with thickness ~few Å-nm have emerged as ideal systems. A classic example of such materials is graphene, where spin currents can travel over tens of microns at room temperature, up to a hundred times longer than in ordinary metals 1 . In this talk, I will introduce how graphene provides unprecedented means to investigate spin currents. A key challenge here is achieving ultimate spin current transport in graphene. However, in graphene spintronic devices with ferromagnetic contacts, the contact interface and substrate roughness significantly impact spin lifetimes and diffusion lengths, and hence the spin conduction through graphene.

Furthermore, the large-scale implementation of graphene spin devices is a prerequisite for practical applications.

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Here, I will discuss our recent understanding of contact interfaces of graphene with oxide tunnel barriers 2 and device fabrication doping effects 3 on spin parameters in graphene. Innovative experiments using large-scale chemical vapor deposited graphene 4 allowed us to achieve longest spin communication of 45 μm and a very high spin lifetime (3.5 ns) in graphene at room temperature. In another development, despite the nanometric surface roughness of flexible substrates, it is possible to develop highly resilient flexible magnetic nanowires 5, which enabled us to realize flexible graphene spin valves and uncover comparatively high-diffusive spin transport in graphene on flexible substrates. These developments pave the way for unprecedented exploration of spin currents in 2D materials and building novel spin memory-logic integrated circuits.

References

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HOST FACULTY

Prof. Anjan Barman

Senior Professor & Dean (Faculty), CONDENSED MATTER AND MATERIALS PHYSICS

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