Enabling efficient and flexible two-dimensional spin current circuits

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Abstract

To explore pure spin currents and advanced spin current circuits, the new class of two-dimensional (2D) materials, that are atomically thin crystals with thickness ~few Å-nm, have emerged as promising systems. A classic example of such materials is graphene, where spin currents can travel over tens of microns at room temperature, up to hundreds of times longer than in typical metals. In graphene spintronic devices, contacts can lead to surface charge transfer doping, impacting the electrical properties of devices used to investigate spin transport in graphene. This talk will focus on our results on device engineering to minimize contact-induced spin relaxation, leading to the highest spin parameters and the longest spin communication of 45 µm at room temperature [1]. Furthermore, realizing highly flexible ferromagnetic nanowires [2] allows us to realize flexible graphene spin devices [3], which show high diffusive spin transport in graphene, despite the rough topography of flexible substrates. These advances open up new opportunities for flexible-integrated large-scale 2D spintronic circuits.

Keywords: *Graphene, spintronics, doping, flexible spintronics, 2D materials*

References

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Biography

M. Venkata Kamalakar is a senior lecturer and the team leader of the Quantum Material Devices group at the Department of Physics and Astronomy, Uppsala University, Sweden. During his Ph.D. at S. N. Bose National Centre for Basic Sciences, India, he investigated electron scattering in magnetic nanowires. Following his Ph.D., he held research positions at the University of Strasbourg in France and Chalmers University of Technology in Sweden, where he contributed to the development of nanoelectronics and spintronics of low-dimensional materials, in particular, the progress of graphene and two-dimensional van der Waals spintronics. In 2015, he joined Uppsala University, where his team currently focuses on next-generation spin current circuits, two-dimensional flexible spintronics, engineering band structure and spin phenomena in quantum materials, steady-state, and ultrafast time-resolved spin dynamics, and developing innovative instrumentation. He is the principal investigator of grants from the Swedish Research Council (VR and Formas) and the Swedish Energy Agency (Energimyndigheten). In 2020, he was awarded the prestigious European Research Council Consolidator Grant for his research.