Spin polarization and Kondo hybridization in the 2-D vdW ferromagnets Fe_nGeTe_2

Deepti Rana[1]
Monika Bhakar[1], Aswini R[1], Basavaraja G.[2], Chandan Patra[3], Satyabrata Bera[4], Sandeep Howlader[1], Neeraj Saini[1], Suman Kalyan Pradhan[4], Rajeswari Roy Chowdhury[3], Mintu Mondal[4], Ravi P. Singh[3], Mukul Kabir[2], and Goutam Sheet[1]

1. Department of Physical Sciences, Indian Institute of Science Education and Research (IISER) Mohali, Sector 81, S. A. S. Nagar, Manauli, PO 140306, India
2. Department of Physics, Indian Institute of Science Education and Research (IISER) Pune, PO 411008, India
3. Department of Physics, Indian Institute of Science Education and Research (IISER) Bhopal, PO 462066, India
4. School of Physical Sciences, Indian Association for the Cultivation Of Science, Jadavpur, Kolkata-700032

ph18062@iisermohali.ac.in

Abstract

The new generation of 2D van der Waals (vdW) ferromagnets belonging to the family of compounds with the general formula Fe_nGeTe_2 (n=3, 4) have emerged as promising candidates for realizing low-power spintronics. With these ferromagnets, it is possible to achieve near-room temperature ferromagnetism, high saturation magnetization, high electrical conductivity, and ease of integration with other materials due to their layered structure making them relevant for efficient spintronic applications. We have given evidence of the coexistence of highly spin-polarised Fermi surface and Kondo lattice behavior in these ferromagnets through point contact spectroscopy (PCS) and scanning tunneling microscopy/spectroscopy experiments (STM/S). Our PCS results on the mesoscopic junctions of these itinerant ferromagnets with conventional superconductors (Nb and Pb) show that both the ferromagnets are capable of generating highly spin-polarized transport current owing to a spin-split band structure along with a higher Fermi velocity of the majority spin channel. Evidence of a hybridization gap indicating the presence of heavy Fermionic character in these systems has been found in the spectroscopic measurements. Owing to the unique coexistence of itinerant ferromagnetism and heavy Fermionic behavior, the FenGeTe2 family of ferromagnets have the potential to give rise to novel emergent quantum phenomena when the physical properties of the system are allowed to mix/interplay with other quantum orders through the heterostructuring of materials.

References

[1] D. Rana, R. Awini, G. Basavaraja , C. Patra, S. Howlader, R. R. Chowdhury, M. Kabir, R.P. Singh, and G. Sheet, Physical Review B, 106 (2022), 085120
[2] D. Rana, M. Bhakar, G. Basavaraja, S. Bera, N. Saini, S. K. Pradhan, M. Mondal, M. Kabir and G. Sheet (Under review in Physical Review B)