

Winter 2024 Joint Colloquium

Materials Department & Materials Research Laboratory

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11:00 am | ESB 1001



Quantum Materials: Magnetism and Catalysis

The research on (quasi) 2D magnetism propelled rapidly since the first experimental discovery of atomically thin magnets in 2017. Since the magnetic properties of bulk (quasi-2D) crystals serve as a basis for the understanding of magnetic phenomenon in reduced dimensions (true 2D limit), a profound knowledge and understanding of these compounds is evidently needed at quasi-2D level, especially considering that magnetic mono and bilayers of a wide range of 2D magnets have now become accessible. In this talk, I will present and discuss our recent findings in tuning the magnetic properties of quasi-2D layered van der Waals magnets by photoexcitation, proton irradiation, intercalation, and by the application of pressure. If time permits, I will briefly discuss our recent efforts in solving the problems related to energy materials by employing magnetometry and electron paramagnetic resonance spectroscopy. NRC, ACS PRF, NSF, and DOE supported this work.

References:

1. Magnetic Properties of intercalated quasi-2D $\text{Fe}_{3-x}\text{GeTe}_2$ van der Waals magnet, npj 2D Materials and Applications (2023) 7:56
2. Pressure-Dependent Magnetic Properties of Quasi-2D $\text{Cr}_2\text{Si}_2\text{Te}_6$ and $\text{Mn}_3\text{Si}_2\text{Te}_6$, J. Phys. Chem. C 127, 10324 (2023)
3. Helicity-Dependent Coherent Spin-Phonon Oscillations in the Ferromagnetic van der Waals Crystal CrI_3 , Nature Communications, 13, 4473 (2022)
4. Pressure dependent magnetic properties on bulk CrBr_3 single crystals, Journal of Alloys and Compounds 911, 165034 (2022)
5. Light Induced Electron Spin Resonance Properties of van der Waals CrX_3 (X = Cl, I) Crystals, Applied Physics Letters 117, 082406 (2020)
6. Enhanced magnetization in proton irradiated, $\text{Mn}_3\text{Si}_2\text{Te}_6$ van der Waals crystals, Appl. Phys. Lett. 116, 172404 (2020)
7. Coherent Spin-Phonon Coupling in the Layered Ferrimagnet $\text{Mn}_3\text{Si}_2\text{Te}_6$, arXiv:2308.14931v1 (submitted, 2023)

8. Raman fingerprints of spin-phonon coupling and magnetic transition in an organic molecule intercalated Cr₂Ge₂Te₆, arXiv:2312.01270 (submitted, 2023)
9. Spin-Selective Oxygen Evolution Reaction in Chiral Iron Oxide Nanoparticles: Synergistic Impact of Inherent Magnetic Moment and Chirality, Nano Letters 23, 9042 (2023)
10. Room Temperature Spontaneous Pt Reduction on Defective BN for Single Atom Catalysis: A promising scalable, robust, low-cost, and efficient catalytic alternative to bulk Pt, Materials Today 51, 108 (2021)

<https://nanomaterialslabutep.wixsite.com/snrg>

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