Controlling Collective Excitations in $NiPS_3$-Based 2D Antiferromagnets

Scientific Achievement

This work establishes mixed MPX_3 correlated antiferromagnets as a tunable platform where excitonic and spin correlation signatures can be engineered independently.

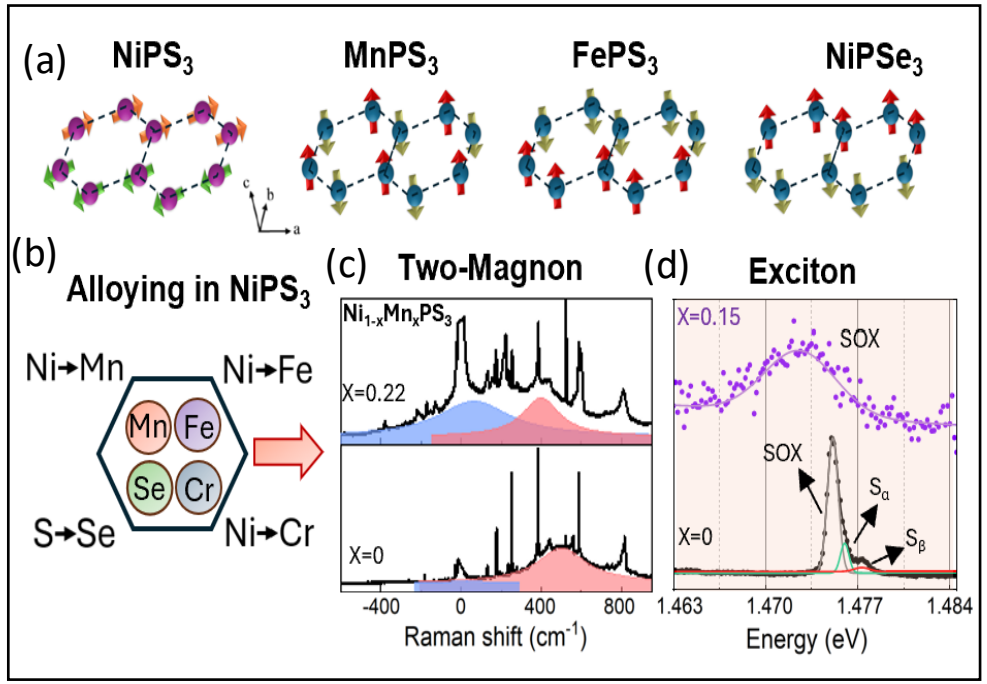

Figure: (a) Magnetic structure of representative MPX_3 compounds. (b) Alloying routes in NiPS3 via metal and chalcogen substitution. (c) Two magnon (2M) Raman scattering shows relative robustness against alloying. (d) Spin-orbit-entangled (SOX) emission is strongly modified by composition.

Significance and Impact

This decoupled control enables the design of magneto-optical functionalities in 2D magnets without changing the device architecture.

Research Details

- Synthesized a family of $NiPS_3$-based alloys via controlled substitution.
- Tracked SOX evolution using temperature-dependent, polarization resolved photoluminescence.
- Quantified two magnon Raman scattering as a probe of short-range spin correlations.

Work was performed at the Center for Integrated Nanotechnologies.

Trinh, C. T.; Liu, N.; Basnet, R.; Upreti, D.; Karkee, R.; Chandrasekaran, V.; Jones, A. C.; Pettes, M. T.; Mai, T. T.; Susner, M. A.; Hu, J.; Rao, R.; Htoon, H. Manipulation of Emergent Collective Excitations via Composition Control in Mixed Mpx3 Correlated 2D Antiferromagnets. *Advanced Science.* 2025.