Discovery of Electric Charge Order in a Potential Quantum Material

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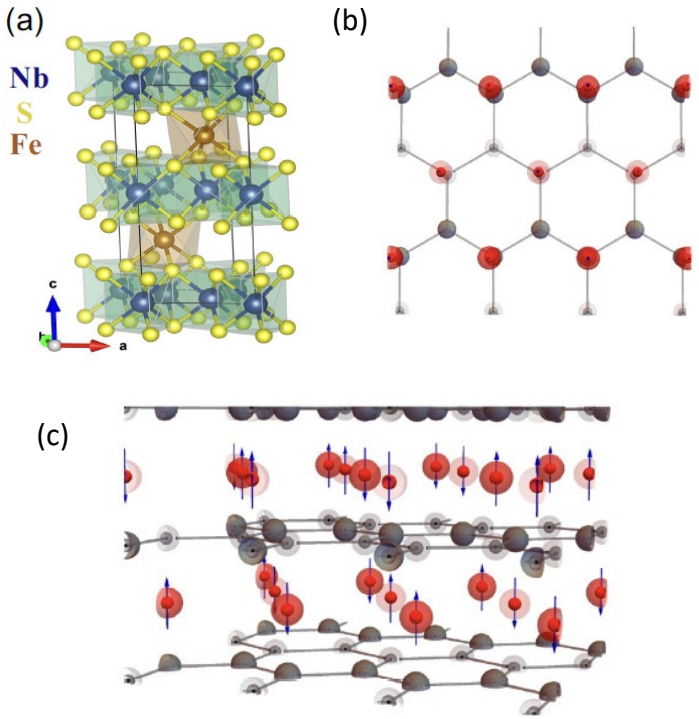
ISR



(a) The crystal structure of $Fe_{0.35}NbS_2$. (b) and (c) Charge order patterns in the over-intercalated (x = 0.35) sample.

*S. Wu, R. Basak, W. Li, J. Kim, P. Ryan, D. Lu, M. Hashimoto, C. Nelson, R. Acevedo-Esteves, S.C. Haley, J.G. Analytis, Y. He, A. Frano, R.J. Birgeneau. Phys Rev Lett **131**, 186701 (2023). doi: 10.1103/PhysRevLett.131.186701*

Work performed in part at NSLS-II

Scientific Achievement

A novel charge order phase was discovered in iron niobium disulfide, an intercalated transition metal dichalcogenide (TMD).

Significance and Impact

This is the first instance of a charge order phase in the intercalated TMDs, suggesting that Fe_xNbS_2 is a strongly correlated electron system; it may have future applications in quantum computing, energy-efficient storage, and other frontier technologies.

Research Details

- Over- and under-intercalated samples were studied, in part, with X-ray scattering at NSLS-II's ISR beamline.
- Results show that excess Fe atoms (x = 0.35) lead to a new charge order, which is unexpected compared to the charge density waves that are known to arise in TMDs.
- Charge order modulation is attributed to a strong coupling between the local magnetism and the atomic lattice.

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