

Finding Order in Disorder: A New Route to Multifunctional Electronics

Scientific Achievement

“Entropy engineering” strategy was used to design high-entropy ferrite thin films with tailored electrical and magnetic properties. Despite substantial atomic-scale chemical disorder, the films retained structural coherence and exhibited rare coexistence of long-range magnetic order and relaxor ferroelectricity – multiferroic behavior.

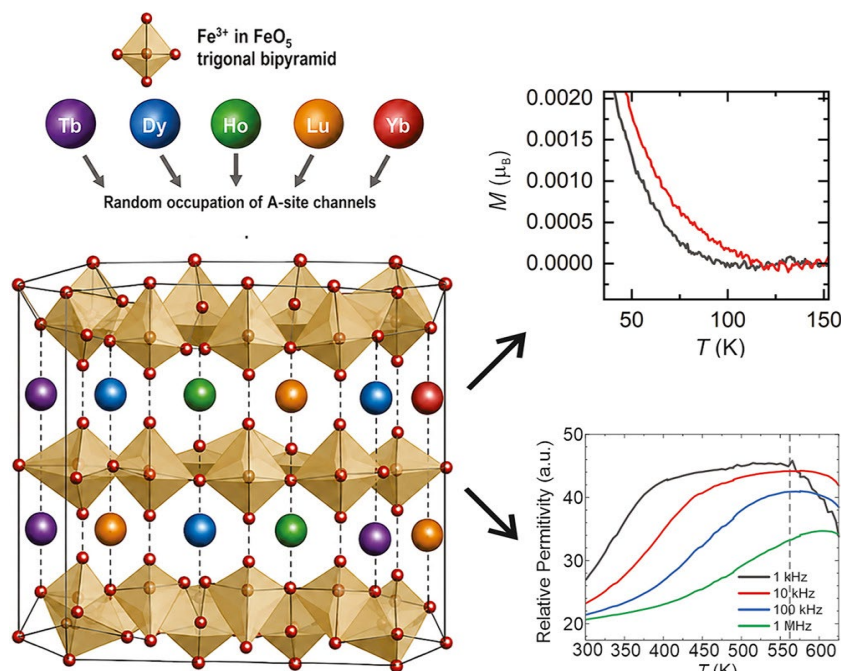


Figure: Schematic illustration of high-entropy ferrite thin films, in which five rare-earth cations (Tb, Dy, Ho, Lu, and Yb) randomly occupy the A sites, while Fe occupies the B sites of the perovskite lattice. Right panel presents magnetic and dielectric-permittivity measurements, confirming low-temperature magnetic ordering and high-temperature relaxor ferroelectric behavior.

Significance and Impact

Materials that couple electric and magnetic functionality could support new generations of low-power memory, sensors, and spintronic devices, which use electron spin as well as charge to process or store information.

Research Details

- The team synthesized high-quality epitaxial ferrite thin films containing five rare earth cations ($5R$)FeO₃ using pulsed laser deposition
- A combination of structural, dielectric, magnetic, and synchrotron X-ray measurements revealed that the film supports both relaxor ferroelectricity and long-range ferromagnetic order.

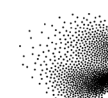
Miertschin, D.; Kunwar, S.; Regmi, B.; Kandel, P.; Thapa, S.; Crater, D.; Basso, L.; Dodson, A.; Gai, Z.; Yao, L.; Chen, Y.W.; Benck, P.; Kleibert, A.; Huang, Y.L.; Mounce, A.; Kotula, P.G.; Dijken, S.V.; Mazza, A.R.; Ward, T.Z.; Shepelin, N.; Farhan, A. Long-range Magnetic Order and Relaxor Ferroelectricity in a Hexagonal High-entropy Ferrite. *Cell Rep Phys Sci* 2026.

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