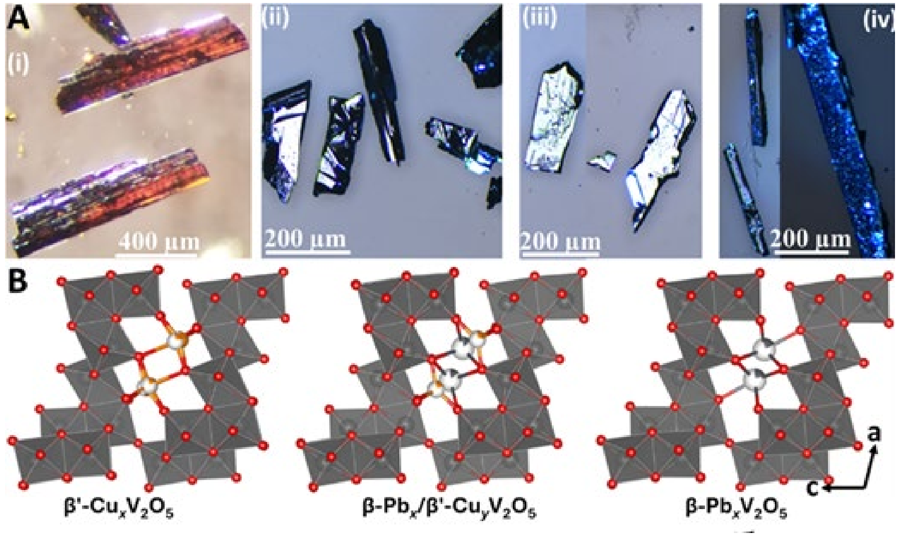
Atomically Precise Materials Improve Artificial Neurons



***(A)** Four related vanadium oxide crystals: (i) ζ-V_2O_5, (ii) β'-$Cu_xV_2O_5$, (iii) β-Pb_x/β'-$Cu_yV_2O_5$, and (iv) β-$Pb_xV_2O_5$. Each has a distinct crystal shape and color, reflecting differences in composition **(B)** Single-crystal X-ray diffraction reveals where Pb and Cu are located within the vanadium oxide material's tunnel-like structure.*

G. Agbeworvi, N. Kumar, J. D. Ponis, S. Hariyani, N. Jerla, F. Jardali, J. Li, W. Zaheer, J. V. Handy, J. R. Ayala, C. Jaye, C. Weiland, D. A. Fischer, P. J. Shamberger, J. Guo, R. S. Williams, G. Sambandamurthy, and S. Banerjee, "An atom-precise approach to damp first-order phase transitions and its implications for neuromorphic signal processing," *Journal of the American Chemical Society* **148**(20), 20677–20693 (2026). https://doi.org/10.1021/jacs.6c02370

Scientific Achievement

Scientists positioned lead (Pb) and copper (Cu) atoms within millimeter-scale single crystals, modifying their charge ordering and producing more stable, neuron-like electrical oscillations.

Significance and Impact

Understanding how atomic-scale changes control a material's electrical switching could enable more reliable, energy-efficient hardware for brain-inspired computing and AI hardware.

Research Details

- Researchers combined X-ray techniques at the PDF, QAS, SST-1, and SST-2 beamlines to reveal how Pb alters the material's atomic structure, local bonding, oxidation states, and electronic structure across multiple length scales.
- The Pb atoms in the crystal's framework alter how electric charge moves, broadening the material's insulator-to-conductor phase.