

Tiny copper clusters could lead to faster, energy-saving electronics

New research advances cutting-edge 'spintronics' technology

By Richard Harth, ASU News
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A new study from researchers at Arizona State University is paving the way for “spintronic” technologies. This new kind of electronics uses the spin of electrons, not just their charge, to store and process information more efficiently.

There are many applications for spintronics, from faster smartphones and computers to advanced memory storage that could hold massive amounts of information in a tiny space.

To accomplish this, scientists need to control electron spin properties in very precise ways. The new research shows how tiny clusters of copper and oxygen atoms could be tailored for this purpose.

Copper has been vital to civilization for thousands of years. But this study dives deep into the material’s smallest building blocks — clusters just billionths of a meter across — to understand how their magnetic and electronic properties can be tuned for tomorrow’s high-tech applications.

The study was led by [Scott Sayres](#), an associate professor with the [Biodesign Center for Applied Structural Discovery](#) and the [School of Molecular Sciences](#) at ASU. The research recently appeared as the [cover story](#) in The Journal of Physical Chemistry Letters.

The team used powerful laser pulses to excite neutral copper oxide clusters and watched how they relaxed back to their original state in less than a trillionth of a second. They discovered that by carefully adjusting the balance of copper and oxygen atoms, they could influence how long these excited states last — and crucially, how magnetic the clusters become.

Traditional electronics rely on the movement of electrical charge. In contrast, spintronics harnesses a property of electrons called “spin” — a kind of tiny internal magnet — to store and process information. It’s like adding a new lane to the data highway, so information can flow faster and more efficiently and more of it can be stored along the way.

“Nearly every time we examine the behaviors of common materials shrunk down to the molecular scale, we find entirely new properties that do not appear in the bulk form and therefore lead us to develop new approaches to advance material science,” Sayres says. “In the case of copper oxides, we found surprisingly large magnetic moments (tiny magnetic fields associated with atoms) that are strongly tied to the local structure that arises uniquely in clusters. This exciting behavior promises to make copper oxide clusters important for many applications.”

Because copper oxides are cheap and abundant, they’re already studied for uses like water splitting for clean-energy applications. Understanding how their magnetic traits change at the smallest scales could unlock entirely new pathways for eco-friendly electronics and even quantum computing.

This story originally appeared on [ASU News](#).

Main image



Electron spin — a quantum property visualized here — behaves like a tiny magnet. Researchers are learning to harness this spin in copper oxide clusters to develop faster, more energy-efficient "spintronic" devices. Graphic by Jason Drees