

Researchers make advances in control of chameleon-like material for next-generation computers

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Credit: Texas A&M University

Researchers from Texas A&M University report significant advances in their understanding and control of a chameleon-like material that could be key to next-generation computers that are even more powerful than today's silicon-based machines.

The existing paradigm of silicon-based computing has given us a range of amazing technologies, but engineers are starting to discover silicon's limits. As a result, for computer science to keep advancing it is important to explore alternative [materials](#) that could enable different

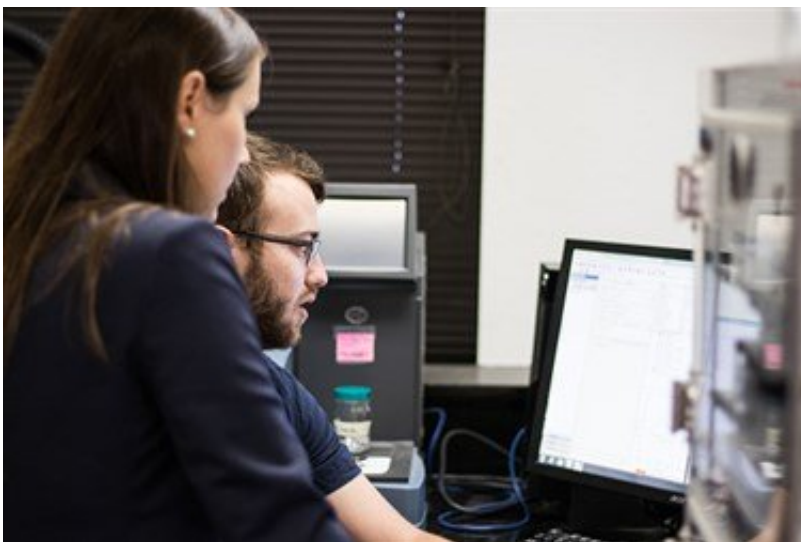
ways to do computation, according to Dr. Patrick J. Shamberger, assistant professor in the Department of Materials Science and Engineering. Vanadium dioxide is one example.

"It's a very interesting, chameleon-like material that can easily switch between two different phases, from being an insulator to being a conductor, as you heat and cool it or apply a voltage," said Dr. Sarbajit Banerjee, professor with joint appointments in the Departments of Chemistry and Materials Science and Engineering. "And if you think about those two phases as being analogous to a zero and a one, you can come up with some interesting new ways of information processing."

Banerjee and Shamberger are corresponding authors of a paper describing their work, which was published in the January 2018 issue of *Chemistry of Materials*.

"Before [vanadium dioxide](#) can be used in computing, we need to better control its transition from insulator to conductor and back again," Shamberger said. In the paper the team describes doing just that by adding tungsten to the material.

Among other things, the researchers showed that tungsten allows the transition to occur over two very different pathways. The result is that the transition from insulator to conductor happens easily and quickly, while the transition from conductor back to insulator is more difficult.



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"Think of it as driving from point A to point B and back again. Going there you take a superhighway, but coming back you're on back roads," Banerjee said.

Essentially the addition of tungsten allows the [vanadium oxide](#) to switch quickly in one direction and much more slowly in the other, phenomena that could be exploited in future computers.

"It provides an additional 'knob' to tune how you go back and forth between the two states," said Erick J. Braham, a graduate student at Texas A&M who was the first author on the paper.

The team has also found that the addition of tungsten allows them to better control, or tune, the different temperatures where the transitions occur.

Banerjee notes the interdisciplinary nature of the work, which involved four groups with expertise ranging from computational [materials science](#)

to electron microscopy, has been key.

"We've really looked at this puzzle from different ends to try to make sense of exactly what's going on," he said. "It's been very exciting."

More information: Erick J. Braham et al. Modulating the Hysteresis of an Electronic Transition: Launching Alternative Transformation Pathways in the Metal–Insulator Transition of Vanadium(IV) Oxide, *Chemistry of Materials* (2017). [DOI: 10.1021/acs.chemmater.7b04203](https://doi.org/10.1021/acs.chemmater.7b04203)

Provided by Texas A&M University

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