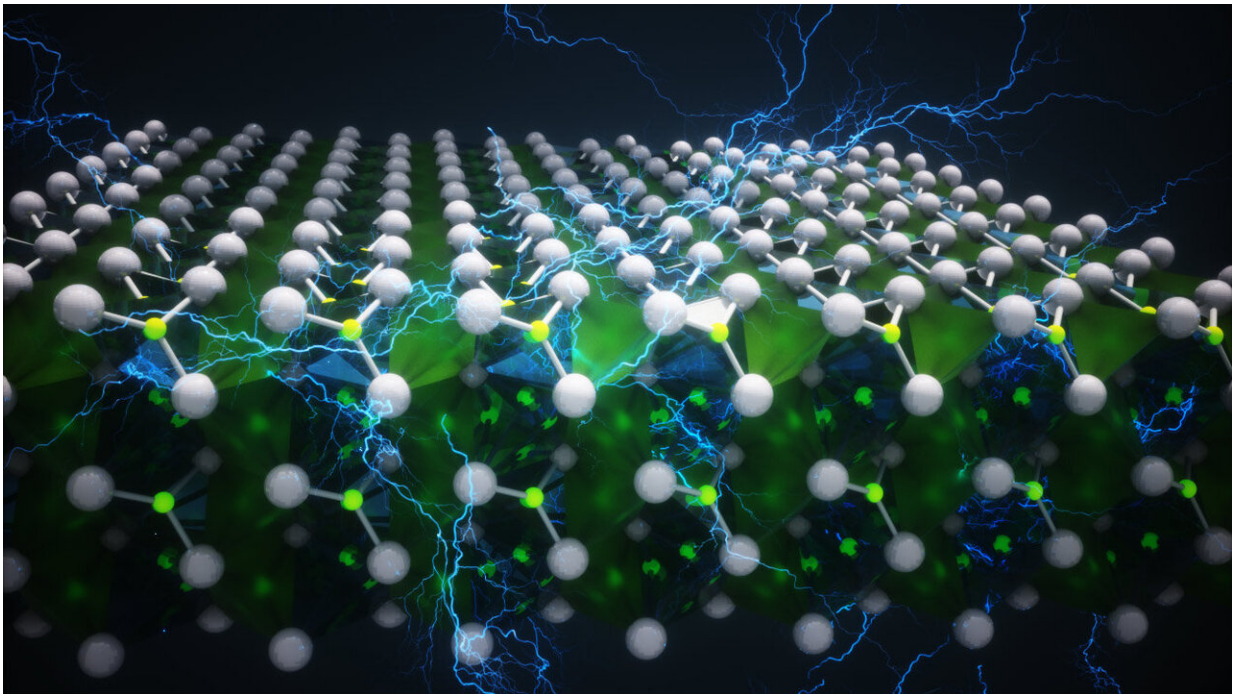


Researchers discover ferroelectricity at the atomic scale

April 23 2020, by Thomas Lee



Credit: University of California - Berkeley

As electronic devices become progressively smaller, the technology that powers them needs to get smaller and thinner.

One of the key challenges scientists face in developing this technology is finding materials that can perform well at an ultrathin size. But now, Berkeley researchers think they may have the answer.

Led by Sayeef Salahuddin, professor of electrical engineering and computer sciences, and graduate student Suraj Cheema, a team of researchers has managed to grow onto silicon an ultrathin material that demonstrates a unique electrical property called ferroelectricity. The duo's findings were published in the April 22 issue of *Nature*.

Ferroelectricity refers to a class of materials that can not only achieve spontaneous electric polarization, but also reverse its direction when exposed to an external electric field, which is promising for electronics.

The team's breakthrough demonstrates ferroelectric effects on a material just 1 nanometer thick, equivalent to the size of just two atomic building blocks. As a result, the material can efficiently power the smallest of devices with lower amounts of energy.

"We are making computing devices that are getting smaller, smaller and smaller," Salahuddin said. "You don't want to use thick materials, because you don't have the space. With our ferroelectric material, you don't really need to worry about space."

Previously, researchers had successfully stabilized ferroelectricity in thinner and thinner materials. But below around 3 nanometers, "ferroelectricity diminishes in conventional ferroelectric materials," Cheema said.

Until now. The Berkeley team grew doped hafnium oxide, one nanometer thick, onto silicon. Not only did the ultrathin material demonstrate ferroelectricity, but the effect was actually stronger than the material several [nanometers](#) thicker—a "fundamental breakthrough" in the field of ferroelectricity, Salahuddin said.

The finding could lead to the creation of more advanced batteries and sensors. But the work holds particular promise for memory and logic

chips in computers.

The discovery of [ferroelectricity](#) in films just 1 nanometer thick means that these storage cells could be scaled down to dimensions below what was believed to be possible before.

"We can grow ferroelectric [materials](#) that can be used in the manufacturing of computer chips today," Salahuddin said.

More information: Suraj S. Cheema et al. Enhanced ferroelectricity in ultrathin films grown directly on silicon, *Nature* (2020). [DOI: 10.1038/s41586-020-2208-x](#)

Provided by University of California - Berkeley

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