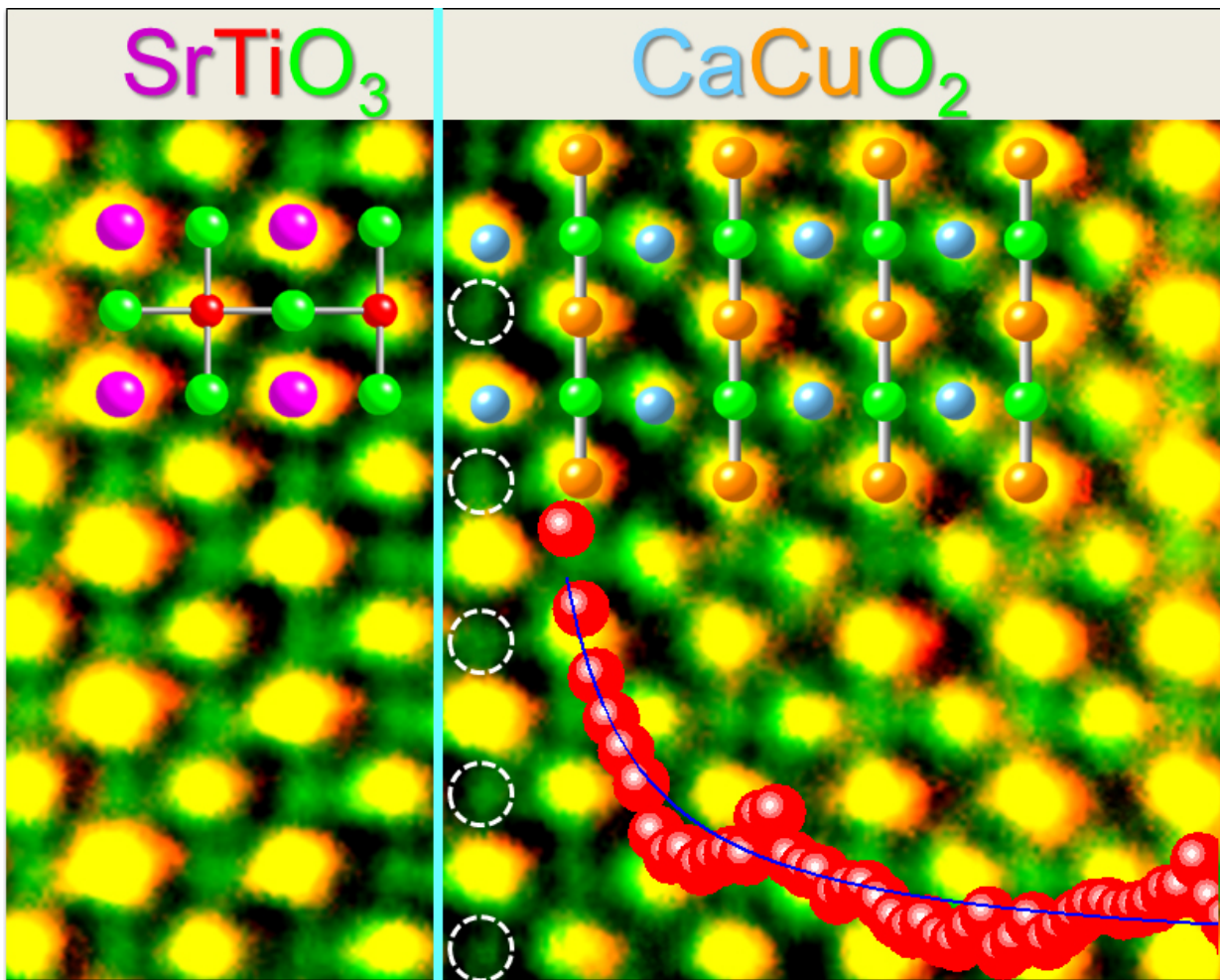


# ORNL microscopy finds evidence of high-temperature superconductivity in single layer

September 30 2015, by Morgan Mccorkle



An ORNL-University of Rome study has delivered direct evidence of high-temperature superconductivity at the interface of two insulating oxide materials. Electron microscopy at ORNL showed that superconductivity arises from oxygen ions (circled in white) that are incorporated into the interface calcium layer.

Electron microscopy at the Department of Energy's Oak Ridge National Laboratory is pointing researchers closer to the development of ultra-thin materials that transfer electrons with no resistance at relatively high temperatures.

The study delivers direct evidence of high-temperature superconductivity at the interface of two insulating oxide materials. The paper by researchers from ORNL and the University of Rome Tor Vergata (Italy) is published in *Physical Review Letters*.

"One grand challenge in science is to manipulate materials locally by changing the distribution of atoms and the electronic structure, and that's what we're doing here," Cantoni said. "This is a way to control the material – by manipulating the oxygen to make this interface superconducting."

The ability to control and confine a material's superconductivity could lead to two-dimensional superconductors for applications such as increasingly smaller computing technologies.

"We always want to scale down to get functionality in thinnest amount of material possible," Cantoni said. "Usually when a material becomes thinner and thinner, its superconductivity disappears."

In the PRL study, researchers used scanning transmission [electron microscopy](#) at ORNL to examine the interface between two insulators, calcium copper oxide and strontium titanate oxide. The resulting data, combined with electron energy loss spectroscopy, confirmed that [high-temperature superconductivity](#) occurs within a highly confined region around the interface.

"We were able to establish that a one-unit-cell-thick calcium copper oxide layer at this interface is superconducting and that the critical temperature approaches 50 Kelvin, which is considered [high temperature superconductivity](#)," Cantoni said.

The team's microscopy showed that superconductivity arises from oxygen ions that are incorporated into the interface calcium layer during the growth process. The extra oxygen ions pull electrons from the adjacent [copper oxide](#) layer, creating holes known to produce superconductivity.

The study is published as "High  $T_c$  superconductivity at the interface between the  $\text{CaCuO}_2$  and  $\text{SrTiO}_3$  insulating oxides."

**More information:** "High- $T_c$  Superconductivity at the Interface between the  $\text{CaCuO}_2$  and  $\text{SrTiO}_3$  Insulating Oxides" *Phys. Rev. Lett.* 115, 147001 – Published 28 September 2015.  
[dx.doi.org/10.1103/PhysRevLett.115.147001](https://doi.org/10.1103/PhysRevLett.115.147001)

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