# Superconductors on the nanoscale

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Superconductors, materials in which current flows without resistance, have tantalizing applications. But even the highest-temperature superconductors require extreme cooling before the effect kicks in, so researchers want to know when and how superconductivity comes about in order to coax it into existence at room temperature. Now a team has shown that, in a copper-based superconductor, tiny areas of weak superconductivity hold up at higher temperatures when surrounded by regions of strong superconductivity.

The experiment is reported in current issue of Physical Review Letters and highlighted with a Viewpoint in *Physics* by Jenny Hoffman of Harvard University.

Researchers have long known that both superconducting and normal currents can leak back and forth between adjacent layers of superconducting material and metal. In copper-based ceramic superconductors, made up of many different elements, superconductivity varies within nanometers depending on which atoms are nearby. These tiny regions can influence each other in much the same way that thin layers of metal and superconductor interact.

Now a collaboration of researchers from Princeton University, Brookhaven National Laboratory, and the Central Research Institute of Electric Power Industry in Japan has used Scanning Tunneling Microscopy to investigate for the first time how this happens on the nanoscale. As they warmed a superconducting sample, they saw that superconductivity died out at different temperatures in regions just a few nanometers apart.

Superconductivity didn't just depend on the characteristics of the local region, but on what was going on nearby. Regions of stronger superconductivity seemed to help regions of weaker superconductivity survive at higher temperatures.

Researchers might exploit this interplay by micromanaging a superconductor's structure, so that regions of strong superconductivity have the maximum benefit to weak regions, potentially resulting in a new material that's superconducting at a higher overall temperature than is possible with randomly arranged ceramic superconductors.

**More information:** Nanoscale Proximity Effect in the High-Temperature Superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$ Using a Scanning Tunneling Microscope, Colin V. Parker, Aakash Pushp, Abhay N. Pasupathy, Kenjiro K. Gomes, Jinsheng Wen, Zhijun Xu, Shimpei Ono, Genda Gu, and Ali Yazdani, Phys. Rev. Lett. 104, 117001 (2010) - Published March 15, 2010, Download PDF (free)

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