Superconductivity is key to conserving energy, says UMR researcher

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Dr. Fatih Dogan, a professor of materials science and engineering at the University of Missouri-Rolla, is working with superconducting materials that might eventually revolutionize the way energy is conserved.

Dogan is an author of a new article about the possible mechanisms of superconductivity at high temperatures. The paper was published this week by *Nature Physics*.

Superconductivity is a phenomenon that occurs in some materials at temperatures hundreds of degrees below zero. The phenomenon is characterized by exactly zero electrical resistance. In ordinary conductors the amount of resistance never reaches zero.

Normal conductors like copper generate heat, causing a certain amount of the energy transported through copper wires to be lost. For the same reason, a lot of energy is wasted in the processes of burning coal and oil. Superconducting materials don't produce heat and are therefore much more energy efficient.

Fifty years ago, Nobel Prize-winning scientists explained the superconductivity of materials at low temperatures. But for the materials to be useful in the transportation of electricity, for example, they would have to be superconductive at much higher temperatures.

"Ideally, we're talking room temperatures or higher," Dogan says. "If we understand the mechanisms of high-temperature superconductivity, we could discover new materials that could be superconducting. Computers would work extremely fast without heating up and power lines could transport electricity on thin lines without losing energy."

Dogan is working with a mixture containing versions of four elements: yttrium, barium, copper and oxygen. In a UMR lab, high-quality crystals of the mixture are grown. The crystals are used by physicists around the world for neutron scattering measurements.

"The periodic table has billions of possibilities," Dogan says. "You have to have a good idea about what might work before you start."

Dogan says physicists and other scientists around the world have been working on the superconductivity problem for a long time. Some of them have turned to Dogan, because he has developed a reputation for being able to grow large crystals of the complex elemental mixture that is believed to have unique qualities conducive to superconductivity at high temperatures.

Powder from the four elements is heated, melted, and then allowed to cool in a disc shape about the size of a silver dollar. The trick to getting the material in the disc to form as a single high-quality crystal, according to Dogan, is to place a seed crystal that melts at higher temperatures in the center of the mixture. Under precisely controlled conditions during the cooling process, the seed crystal colonizes the surrounding material.

Dogan's crystals help physicists understand the mechanisms of high-temperature superconductivity. If more can be learned, new materials might one day be engineered to solve a lot of the world's energy problems.

The latest *Nature Physics* paper is the sixth *Nature* publication on superconductivity materials that Dogan has co-authored.

Source: University of Missouri-Rolla