

Study discovers amazing electrical properties in polymers

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(PhysOrg.com) -- Crystals and ceramics pale when compared to a material researchers at Oak Ridge National Laboratory discovered that has 10 times their piezoelectric effect, making it suitable for perhaps hundreds of everyday uses.

ORNL's Volker Urban and colleagues at Technical University Aachen in Germany noticed the reverse piezoelectric effect - defined as creating a [mechanical strain](#) by applying an [electrical voltage](#) -- while conducting fundamental research on polymers. At first they didn't think about their observations in terms of classic [piezoelectric materials](#), but then they became more curious.

"We thought about comparing the effects that we observed to more 'classic' piezoelectric materials and were surprised by how large the effects were by comparison," said Urban, a member of the Department of Energy lab's Neutron Scattering Science Division.

Until now, scientists did not believe that non-polar polymers were capable of exhibiting any piezoelectric effect, which occurs only in non-conductive materials. This research, however, shows up to 10 times the measured electro-active response as compared to the strongest known piezoelectric materials, typically crystals and ceramics.

"We observed this effect when two different [polymer molecules](#) like polystyrene and rubber are coupled as two blocks in a di-block copolymer," Urban said.

Temperature-dependent studies of the molecular structure revealed an intricate balance of the repulsion between the unlike blocks and an elastic restoring force found in rubber. The electric field adds a third force that can shift the intricate balance, leading to the piezoelectric effect.

"The extraordinarily large response could revolutionize the field of electro-active devices," said Urban, who listed a number of examples, including sensors, actuators, [energy storage devices](#), power sources and [biomedical devices](#). Urban also noted that additional potential uses are likely as word of this discovery gets out and additional research is performed.

"Ultimately, we're not sure where this finding will take us, but at the very least it provides a fundamentally new perspective in polymer science," Urban said.

The paper, titled "Piezoelectric Properties of Non-Polar Block Copolymers," was published recently as the cover article in *Advanced Materials*.

Provided by Oak Ridge National Laboratory

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