

A step toward lead-free electronics

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Research published today by materials engineers from the University of Leeds could help pave the way towards 100% lead-free electronics.

The work, carried out at the UK's synchrotron facility, Diamond Light Source, reveals the potential of a new manmade material to replace lead-based ceramics in countless electronic devices, ranging from inkjet printers and digital cameras to hospital ultrasound scanners and diesel fuel injectors.

European regulations now bar the use of most lead-containing materials in electronic and electrical devices. Ceramic crystals known as 'piezoelectrics' are currently exempt from these regulations but this may change in the future, owing to growing concerns over the disposal of lead-based materials.

Piezoelectric materials generate an electrical field when pressure is applied, and vice-versa. In gas igniters on ovens and fires, for example, piezoelectric crystals produce a high voltage when they are hit with a spring-loaded hammer, generating a spark across a small gap that lights the fuel.

The most common piezoelectric material is a ceramic crystal called lead zirconium titanate, or PZT.

Using a high intensity X-ray beam at the Diamond Light Source, the University of Leeds researchers have now shown that a simple, lead-free ceramic could potentially do the same job as PZT.

"With the 'Extreme Conditions' beamline at Diamond we were able to probe the interior of the lead-free ceramic- potassium sodium bismuth titanate (KNBT) to learn more about its piezoelectric properties. We could see the changes in crystal structure actually happening while we applied the electric field," said Tim Comyn, lead investigator on the project.

"PZT is the best material for the job at the moment, because it has the greatest piezoelectric effect, good physical durability, and can be radically tailored to suit particular applications," said Adam Royles, PhD student on the project. "The lead-free ceramic that we have been studying is lightweight and can be used at room temperature. This could make it an ideal choice for many applications."

In the medical field, PZT is used in ultrasound transducers, where it generates sound waves and sends the echoes to a computer to convert into a picture. Piezoelectric ceramics also hold great potential for efficient energy harvesting, a possible solution for a clean sustainable energy source in the future.

The Leeds team will continue to work at Diamond to study the transformation induced by an electric field at high speed (1000 times per second) and under

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Published on Electronic Component News (<http://www.ecnmag.com>)

various conditions using state of the art detectors.

The results of the work are published online in the journal *Applied Physics Letters*.

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Source URL (retrieved on 10/25/2014 - 2:40am):

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