UK scientists develop optimum piezoelectric energy harvesters

March 2 2012

Scientists working as part of the Metrology for Energy Harvesting Project have developed a new model to deliver the maximum power output for piezoelectric energy harvesters.

Piezoelectric materials convert electrical energy into a strain (or vice-versa). The best known use of piezoelectricity is for medical ultrasound.

Piezoelectric energy harvesters utilise energy from unwanted mechanical vibrations, such as the rattling of an air conditioning duct or the movement of a bridge with passing traffic. Power levels are small, usually a few milli-watts or less, but the scavenged energy could be used to power autonomous devices such as wireless sensors.

Piezoelectric energy harvesters are typically vibrating cantilevers, covered with a piezoelectric layer that converts mechanical strain to an electrical charge to power devices. Most developers cover the entire length of the cantilever with piezoelectric material in an attempt to maximise the conversion efficiency.

However, scientists based at the UK's at National Physical Laboratory, one of seven national measurement institutes involved in the European Metrology Research Programme funded project have discovered that this approach is counterproductive. Their research shows that due to the charge redistribution across the cantilever there is an internal loss of power of up to 25% of potential output. To counter this the team has developed a model to show that more energy can be converted if the

beam is only covered with piezoelectric for two thirds of its length.

Current piezoelectric energy harvesting devices are used in applications such as wireless and battery-less light switches, and sensors. However, their potential applications range from the predictive maintenance of any moving or rotating machine parts, to electronic devices that harvest their own wasted operational energy to be more energy efficient.

Harvesting energy that would otherwise be wasted is key to meeting future energy demands while reducing carbon emissions. This energy can come from light, heat, movement or vibrations.

Markys Cain, Knowledge Leader at NPL, said:

"The energy harvesting market was worth $605 million in 2010 but is predicted to reach $4.4 billion by the end of this decade. For the market to reach its true potential we need to develop the products that can guarantee a greater energy yield and drive industrial adoption of energy harvesting products. The work undertaken by the Functional Materials Group at NPL will do exactly that, providing a model for more efficient piezoelectric energy harvesting methods."

The research was originally published in *Applied Physics Letters* 100, 073901 (2012).

Provided by National Physical Laboratory