Team builds implantable piezoelectric nanoribbon devices strong enough to power pacemaker (w/ Video)

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Thin, flexible mechanical energy harvester, with rectifier and microbattery,

mounted on a curved glass support. Credit: University of Illinois and University of Arizona.

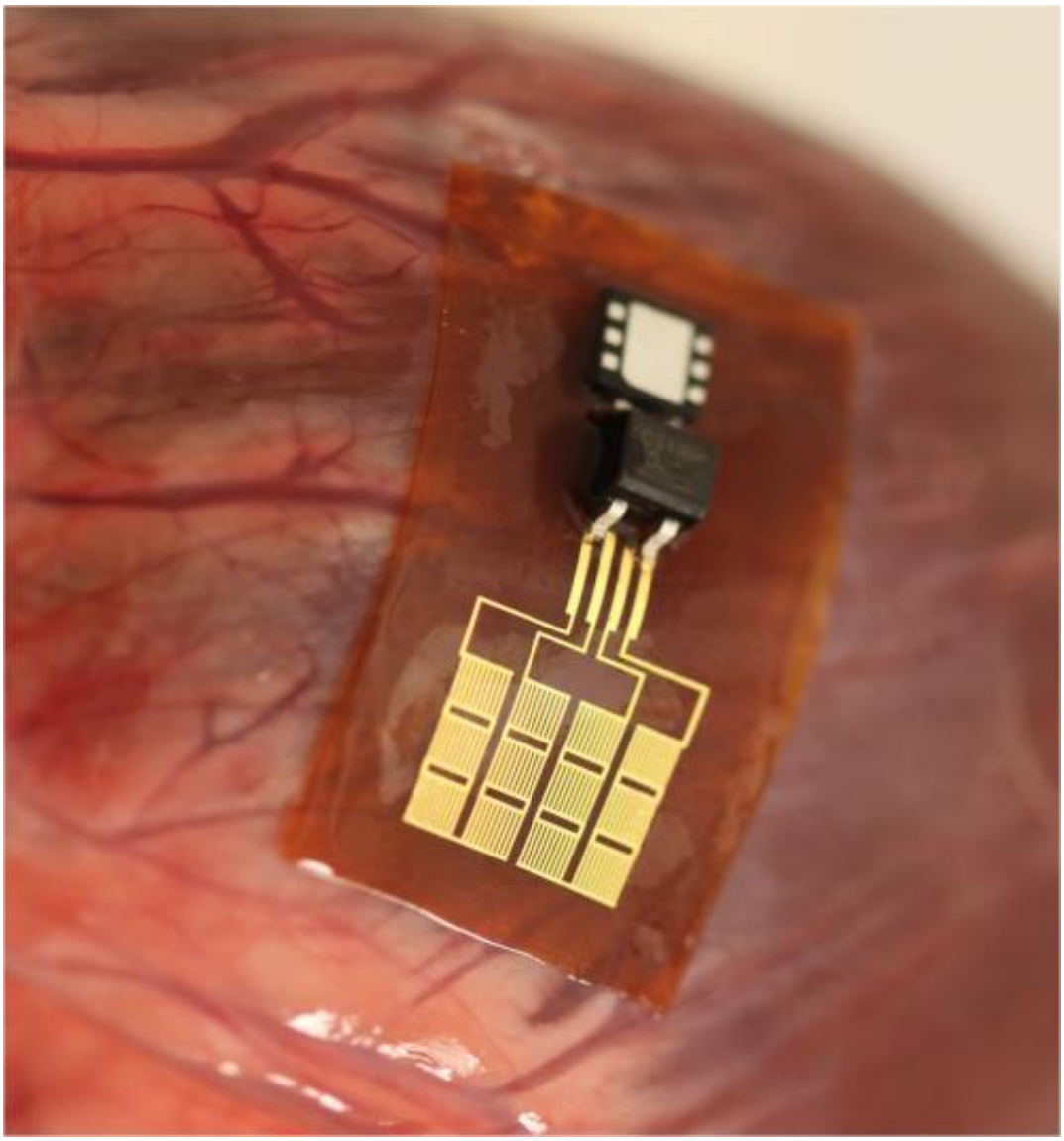
(Phys.org) —Researchers from several institutions in the U.S. and one from China have together developed a piezoelectric device that when implanted in the body onto a constantly moving organ is able to produce enough electricity to run a pacemaker or other implantable device. In their paper published in *Proceedings of the National Academy of Sciences*, the team describes the nature of their device and how it might be used in the future.

Currently, when the battery inside a device such as a pacemaker runs out of power, patients must undergo surgery to have it replaced. Several devices that take advantage of the body's natural parts have been devised to allow for the creation of electricity internally so that implantable devices can run for a lifetime, preventing the need for additional surgery. Most such devices have been too small to actually charge a real device, however, as they are very much still in the research stage. In this new effort, the research team takes the idea further by creating miniature power plants that are large enough to power real implantable devices.

The new device has nanoribbons that are made of lead zirconate titanate—they are covered by flexible, biocompatible plastic, as are the other two main parts: an integrated rectifier and a rechargeable battery. The device is sewn directly onto the heart, lung or diaphragm—all parts that are in constant motion—as the body parts move, they cause the ribbons to bend slightly, which in turn causes the creation of a small amount of electricity. Thus far, the devices have been tested on cows and other large animals—the team reports that they are able to create enough electricity to power a pacemaker or other implantable device

indefinitely.

The devices aren't ready for clinical trials just yet, of course, there is still the issue of figuring out if suturing devices onto important organs causes damage. Also, long term testing will need to be done to ensure that the devices are able to survive inside the body for as long as would be needed, and a replacement for lead will likely have to be found as placing a toxic substance inside a device so close to a vital organ would seem incongruous.



Thin, flexible mechanical energy harvester, with rectifier and microbattery, mounted on the bovine heart. Credit: University of Illinois and University of Arizona.

More information: "Conformal piezoelectric energy harvesting and storage from motions of the heart, lung, and diaphragm," by Canan Dagdeviren et al. www.pnas.org/cgi/doi/10.1073/pnas.1317233111