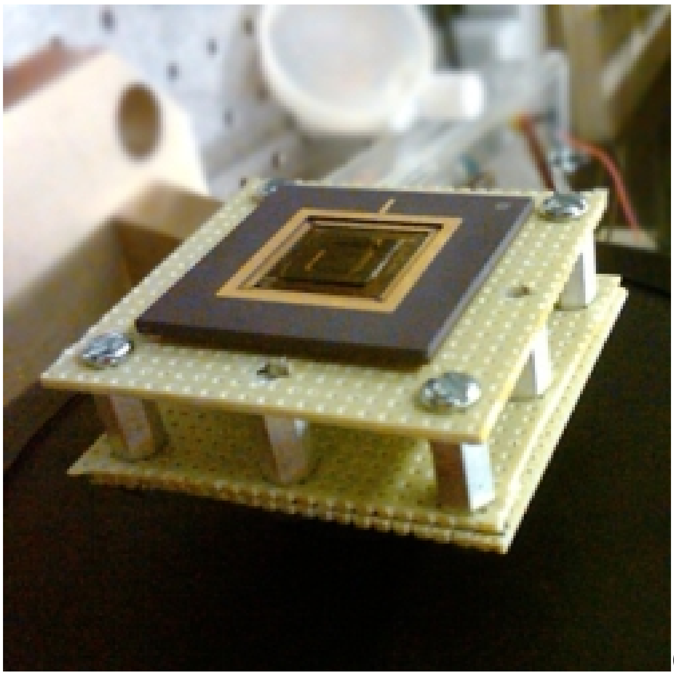
MIT Researchers Create Vibration-Driven MEMS Energy Harvester

(MIT News [1]) - Today's wireless-sensor networks can do everything from supervising factory machinery to tracking environmental pollution to measuring the movement of buildings and bridges. While uses for wireless sensors are seemingly endless, there is one limiting factor to the technology — power.

To get around the power constraint, researchers are harnessing electricity from low-power sources in the environment, such as vibrations from swaying bridges, humming machinery and rumbling foot traffic. Such natural energy sources could do away with the need for batteries, powering wireless sensors indefinitely.

Now researchers at MIT have designed a device the size of a U.S. quarter that harvests energy from low-frequency vibrations, such as those that might be felt along a pipeline or bridge. The tiny energy harvester — known technically as a microelectromechanical system, or MEMS — picks up a wider range of vibrations than current designs, and is able to generate 100 times the power of devices of similar size. The team published its results in the Aug. 23 online edition of *Applied Physics Letters*.

Putting the squeeze on

Various groups have gravitated toward a common energy-harvesting design: a small microchip with layers of PZT glued to the top of a tiny cantilever beam. As the chip is exposed to vibrations, the beam moves up and down like a wobbly diving board, bending and stressing the PZT layers. The stressed material builds up an electric charge, which can be picked up by arrays of tiny electrodes.

However, the cantilever-based approach comes with a significant limitation. The beam itself has a resonant frequency — a specific frequency at which it wobbles the most. Outside of this frequency, the beam's wobbling response drops off, along with the amount of power that can be generated.

To address the problem, some researchers have taken a "power in numbers" approach, simply increasing the number of cantilever beams and PZT layers occupying a chip. However, Kim and Hajati say this tactic can be wasteful, and expensive.

Bridging the power divide

Kim and Hajati came up with a design that increases the device's frequency range, or bandwidth, while maximizing the power density, or energy generated per square centimeter of the chip. Instead of taking a cantilever-based approach, the team went a slightly different route, engineering a microchip with a small bridge-like structure that's anchored to the chip at both ends. The researchers deposited a single layer of PZT to the bridge, placing a small weight in the middle of it.

The team then put the device through a series of vibration tests, and found it was able to respond not just at one specific frequency, but also at a wide range of other low frequencies. The researchers calculated that the device was able to generate 45 microwatts of power with just a single layer of PZT — an improvement of two orders of magnitude compared to current designs.

CLICK HERE [2]to read the entire article on the MIT site.

Links:
[1] http://web.mit.edu/newsoffice
[2] http://web.mit.edu/newsoffice/2011/power-from-vibrations-0914.html