Magnetic Energy Harvesting Using Magnetostriction

A magnetic energy harvesting device has been demonstrated using Magnetostriction. It harvests material stress and vibrations, but it is not a piezoelectric device. The latest demonstration is producing over 2 watts.

History

Back in 2010 a Japanese university researcher developed a small-size vibration-driven generator that measures approximately 2 x 3 x 12mm and can output a power of 1.56mW with a vibration of 357Hz. The energy density of the generator, which was developed by Toshiyuki Ueno, associate professor at Kanazawa University, is about 22mW/cm^3. It is about 20 times higher than the energy density of normal small-size vibration-driven generators, which is about 1mW/cm^3.

Magnetostriction effect is a phenomenon in which the shape of an object changes due to magnetization. The power generating element, uses a magnetostrictive material called "Galfenol" ($Fe_{81.4}Ga_{18.6}$), which is an alloy of iron (Fe) and gallium (Ga) and has a large magnetostriction effect.Galfenol was developed by the US Naval Research Laboratory (NRL) in 1998. But this is the first time that it has been used for a vibration-driven generator of small size To generate electricity, Ueno used inverse magnetostriction effect, which is the converse phenomenon of magnetostriction effect. Inverse magnetostriction effect is a phenomenon in which the application of stress changes magnetization.

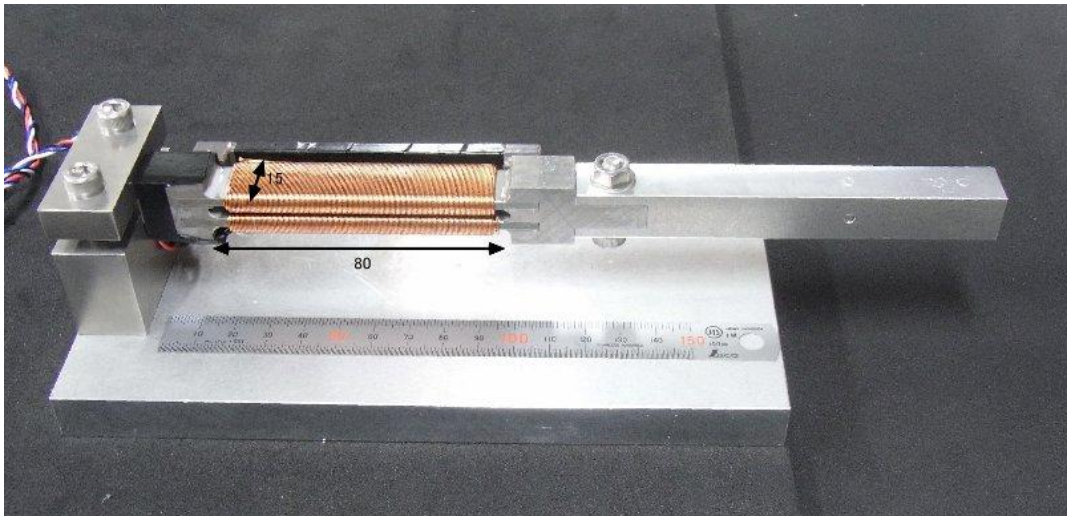
Specification

In the case of Galfenol, its magnetic flux density decreases by up to more than 1T when compressional stress is applied. And the change in magnetic flux generates an induced voltage. Galfenol is a ductile material. Therefore, it can be easily processed by

machines, and it does not easily break when warped. Piezoelectric elements, which are normally used for vibration induced power generation, are made of a ceramic, which is a brittle material. Galfenol features an excellent thermal property. Its Curie temperature is as high as 700°C, and its performance does not change much within the temperature range of -200 to 200°C.

Increased Power Output

The latest manifestation is a 2 watt device. Toshiyuki Ueno developed a vibration-driven generator that can generate 2W of electricity.The dimensions of the generator are as small as 250 (L) x 20 (W) x 20mm (H). The new generator is targeted at automobiles and home electric appliances. Ueno announced the generator June 22, 2011, at Energy Harvesting & Storage Europe 2011, He gave a demonstration of tapping the generator to light 50 LEDs .



Quoting associate professor Toshiyuki Ueno "I found that, by using magnetostriction effect, it becomes possible to use a vibration-driven generator with a practical size for generating a practical amount of electricity," he said. "By further increasing the size by 1,000 time, it will become possible to realize a vibration-driven generator that can generate several kilowatts of electricity and can be used for a residence."

The new generator has the same structure as the previous generator. One ends of two long and thin magnetostrictors are fixed, and weights are attached to the other ends (parallel beam structure). Thin electric wires are wrapped around the magnetostrictors

so that they can be used as coils. And electricity is generated by contorting the magnetostrictors with vibration.

This time, the large-size generator was realized because Etrema Products Inc, which supplies magnetostrictive materials, succeeded in enlarging its power-generating elements and because Ueno obtained knowledge that enables to firmly attach power-generating elements, oscillators, etc, he said"

Conclusion.

This possibilities of this technology as a viable alternative for piezoelectric materials, given the extreme temperature range and power out puts is promising. It is in its early stages but the applications are endless as a viable energy harvesting device. Many companies are supplying materials and devices built on this technology for a variety of applications already. The following are links offerer further information including history , applications and porducts.

Source: http://revolution-green.com/magnetic-energy-harvesting-using-magnetostriction/