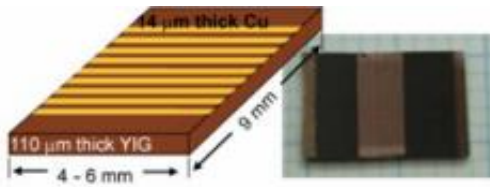


Magnetic field sensors for monitoring heart and brain activity developed

September 2 2011, By Adarsh Sandhu



Schematic illustration (left) and photograph (right) of the one-dimensional magnonic crystal. Credit: Toyohashi Tech

High sensitivity magnetic sensors are important in medical diagnostics for applications such as monitoring heart and brain activities, where mapping distributions of localized extremely weak magnetic fields arising from these organs could provide early warning of life threatening diseases and malfunction.

Mitsuteru Inoue and colleagues at Toyohashi University of Technology (Toyohashi Tech, Japan) have developed [high sensitivity magnetic sensors](#) using magnonic crystals—artificial magnetic crystal structures capable of controlling the propagation of magnetostatic waves. Magnonic crystals support the propagation of magnetostatic waves through the crystal spin system or suppress the propagation of waves due to the periodicity of the crystal structure.

In this research the Toyohashi Tech researchers fabricated magnonic

crystals by the direct formation of one-dimensional arrays of metal strips on yttrium iron garnet (YIG)—a ferromagnetic material widely used in the magneto-electronics industry— which serves as the propagation medium. The metal stripes induce an attenuation band in the frequency spectra of the magnonic crystal and restrict the propagation of waves of specific frequencies.

Even at room temperature, the output signal of the devices—frequency of the attenuation band—is very sensitive to external magnetic fields applied to the YIG crystal, where a one Oersted change in the field causes a 2.6 MHz shift in the attenuation band gap. Importantly, the maximum detection sensitivity of the magnonic crystals is more than 10 times greater than that of giant magneto-impedance devices.

Next the researchers are planning to demonstrate the measurement of magnetic fields in three dimensions.

More information: Mitsuteru Inoue et.al (2011) :Investigating the use of magnonic crystals as extremely sensitive magnetic field sensors at room temperature. *Applied Physics Letters* 98, 132511. [DOI: 10.1063/1.3567940](https://doi.org/10.1063/1.3567940)

Provided by Toyohashi University of Technology

Citation: Magnetic field sensors for monitoring heart and brain activity developed (2011, September 2) retrieved 10 April 2024 from <https://phys.org/news/2011-09-magnetic-field-sensors-heart-brain.html>

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