Researchers develop a simple but extremely sensitive magnetometer

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VTT Technical Research Centre of Finland has developed an innovative magnetometer that can replace conventional technology in applications such as neuroimaging, mineral exploration and molecular diagnostics. Its manufacturing costs are between 70 and 80 per cent lower than those of traditional technology, and the device is not as sensitive to external magnetic fields as its predecessors. The design of the magnetometer also makes it easier to integrate into measuring systems.

Magnetometers are sensors that measure magnetic fields or changes in magnetic fields. The kinetic inductance magnetometer developed by VTT makes use of the dependence of superconductors' electrical properties on magnetic fields. This has allowed research scientists to develop an innovative sensor element which is considerably more simplistic than conventional SQUID sensors.. The new magnetometer is based on a single patterned thin film. It can be fabricated in a single-phase process unlike SQUID sensors, which require a layered structure and a multi-phase fabrication process.

The manufacturing costs of VTT's new magnetometer are estimated to be between 70 and 80 per cent lower than those of a corresponding SQUID sensor. It is also less sensitive to external disturbances such as the earth's magnetic field or electrical systems than its predecessors. This property will be useful in the development of new medical imaging techniques, such as magnetic resonance imaging based on ultra-low magnetic fields where the measuring fields can be commensurate with the earth's magnetic field.

Highly sensitive magnetometers are needed in medicine, for example, to detect minuscule changes in magnetic fields caused by nerve signals. In the context of neuroimaging this technique is called magnetoencephalography (MEG), and it can be used to locate pathological activity in patients with epilepsy who require surgical treatment, to diagnose autism or to map brain activity more generally. Magnetometers are also used in the mining industry for mineral exploration, in industrial quality control and in certain security applications.

VTT's innovative magnetometer is expected to hit the market in a few years' time.

More information: "Juho Luomahaara, Visa Vesterinen, Leif Grönberg & Juha Hassel, Kinetic inductance magnetometer," *Nature Communications* 5, Article number: 4872, DOI: 10.1038/ncomms5872

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