Magnetic field sensors for high-pulsed magnetic field measurements.

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The demand for new magnetic field sensing technologies is increasing rapidly due to the development of advanced scientific and industrial devices and techniques such as non-destructive pulsed-field magnets, flux compression generators, mass acceleration, high power electrical motors, electromagnetic welding systems and other applications. Each application has specific requirements for the sensor fabrication, its characteristics, range of operation, accuracy, etc.

The response signal from commercially available magnetic field sensors based on Hall or anisotropic magnetoresistance effects depends on the magnitude and the direction of magnetic field. Therefore, such sensors cannot be applied in cases if both the magnitude and the direction of the field changes simultaneously during measurement. For this reason the sensors, which could measure magnitude of the magnetic field independently on its direction, are of great interest. Recently, it was demonstrated that the colossal magnetoresistance (CMR) phenomenon in thin nanostructured manganite films can be successfully used for the development of CMR-B-scalar sensors, which are able to measure the magnitude of high pulsed magnetic fields up to the megagauss limit in a very small volume of $\approx 10^{-2}$ mm^3. A high pulsed magnetic field measurement system based on these sensors was developed by the group of scientists in the Center for Physical Sciences and Technology. The system is protected against strong electromagnetic interference and is able to measure the magnitude of pulsed magnetic fields from 20 mT to 40 T in the range from DC up to 100 kHz independently of the magnetic field direction. The created meter was successfully used for investigations of electrodynamic processes in electromagnetic launchers (railguns), for investigation of magnetic field dynamics during electromagnetic metal forming and welding, and for measuring of strong pulsed magnetic field in non-destructed magnets.

Recent investigations on manganite thin films used for magnetic field sensors fabrication will be presented and discussed. The change of technological conditions allows to tune the magnetoresistive properties of the films what enables to develop the magnetic field sensors operating in different magnetic field and temperature ranges.