NSYSU physics

書報討論 Weekly Seminar

Systematic Development And Commercialization Of Miniaturized Optically Pumped Magnetometers

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Optically pumped magnetometers (OPMs) are vector-type quantum sensors that measure magnetic fields by detecting polarization changes of laser light interacting with alkali atoms under ultra-low magnetic fields. In our tabletop system, we used a 4×4×4 mm3 borosilicate glass vapor cell filled with natural rubidium or isotopically enriched 87Rb atoms and approximately 500 torr of nitrogen buffer gas. The cell was heated above 160 to operate in the spin-exchange relaxation-free (SERF) regime and placed inside a four-layer -metal shield, where internal compensation coils reduced the residual magnetic field below 1 nT. After system optimization, a best sensitivity of 3 fT/Hz was achieved within the MEG frequency range of 3–100 Hz.

Based on the tabletop platform, we further developed a commercial OPM sensor using a 3×3×3 mm3 MEMS vapor cell to significantly reduce the sensor size. A biplanar coil system was also implemented for magnetic-field compensation to maximize field uniformity inside the sensing region.

Due to their compact size and relatively low cost, OPMs show strong potential for applications in magnetoencephalography (MEG), neuroscience, and biomedical diagnostics.

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