Low stand off optical magnetometer for biomedicine

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Magnetic field sensing in biomedical applications commonly aims on magnetic source localization in the examined object [1]. For small-sized magnetic sources lowest possible stand off distance is an important argument in choosing the sensor, since their dipolar fields fade out cubically with distance. Best stand off distanse for currently available OPMs is more than 5 mm, defined by the wall thickness of the sensing vapor cell and spin relaxation due to atomic collisions with inner wall surface. Notably in biomagnetic applications thickness of thermal isolation plays a critical role, since most commonly deployed Rb or K vapors are strongly heated, especially in SERF OPMs. Good thermal isolation increases stand off distance, but is crucial for the practical masurements on the living tissue, magnetic nanoprobes such as superparamagnetic iron oxide nanoparticles, or NMR in fluid or tissue samples.

We design and investigate the operation of an OPM sensor featuring direct access to the vapor cell wall and thus minimizing the distance to the field source. Thermal isolation is not applied to the cell of our sensor since an ambient temperature Cs vapor is used. A small atomic subensemble is selected by a narrow continuous pump beam in close vicinity to the cell wall exposed to the sample [2]. The use of buffer gas at moderate pressure immobilizes the spin-polarized atoms at shortest (down to 2 mm) stand off to the sample.

We will report on the current staus of the project and preliminary results.

References

[1] P.J. Broser, T. Middelmann, D. Sometti, C. Braun, J. Electromyogr. Kinesiol. **56**, 102490 (2021).

[2] V. Lebedev, S. Hartwig, T. Middelmann, Adv. Opt. Technol. **9**, 275 (2020).