Challenges and solutions of fabricating fully integrated alkali vapour cells

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The aim of our work is to fabricate fully integrated alkali vapour cells for optically pumped magnetometers (OPMs), which are used as magnetic field sensors for biological and geological applications. Since these OPMs require specific characteristics depending on the measuring task, we need to adjust the alkali cells properties by their design, functionalised surfaces, and buffer-gas pressure. While glass blown alkali vapour cells and glass-silicon-glass anodic bonded cells both offer the possibility to control some cell characteristics such as temperature distributions, optical properties of surfaces and heat radiation, only glass-silicon-glass anodic bonded cells enable a wafer-scale process. In order to control the parameters of these anodic bonded OPMcells, different features are deployed including transparent electrical heaters, anti-reflection coatings as well as optical and heat mirrors. Some of those require low-temperature bonding of glass sheets as optical cell windows for encapsulation at room temperature [1] and a passivation of the cell inner surfaces or coatings exposed to the alkali vapour for increasing their lifetime [2]. Those features will be presented on examples of alkali vapour cells for OPMs with different design which are designed to utilize the light shifted dispersed Mz mode [3] for applications such as a magnetic field imaging by an OPM-type camera and foetal magneto-encephalography.

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[2] S. Woetzel, F. Talkenberg, T. Scholtes, R. IJsselsteijn, V. Schultze and H.-G. Meyer, Lifetime improvement of micro-fabricated alkali vapor cells by atomic layer deposited wall coatings, Surface and Coatings Technology **221**, 158 (2013)
[3] Volkmar Schultze, Bastian Schillig, Rob IJsselsteijn, Theo Scholtes, Stefan Woetzel and Ronny Stolz, An Optically Pumped Magnetometer Working in the Light-Shift Dispersed Mz Mode, Sensors **17**, 561 (2017)