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Laser cleaning optical windows of alkali vapor cells

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Alkali vapor cells are at the heart of a variety of atomic systems and quantum sensors, including atomic clocks and gyroscopes, laser frequency references, Rydberg atom-based electric field sensors, and especially for this work, optically pumped magnetometers. In state-of-the-art, wafer-scale vapor cell fabrication technology, the alkali metal is often introduced as a chemical compound into the cells [1]. The elemental alkali metal is subsequently released inside the sealed cells by additional steps, for example using photolysis [2,3] or other chemical reactions [4,5]. In these approaches, unwanted substances typically remain inside the cells, e.g., residues of reactants or reaction byproducts. When these contaminations remain at the optical windows of the cells, they can degrade the performance of the cells and limit the reproducibility of their (optical) properties.

In this work, we present a method for cleaning the optical windows of alkali vapor cells based on femtosecond laser ablation. We demonstrate removal of the residues released from an alkali metal dispenser pill and remains of cesium azide from the optical windows of microfabricated Cs cells. We evaluate the efficiency of the laser cleaning process by comparing the optical transmission of a cleaned area with that of a still-contaminated region of the same cell. In addition to that, the spectra of the cells before and after the treatment have been compared with respect to a possible change of the background pressure of the buffer gas.

References

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