Spectroscopy in a micro-fabricated Rb cell with anti-relaxation wall-coating

Matthieu Pellaton[1], Rahel Straessle[2,*], Christoph Affolderbach[1], Yves Pétremand[2,*], Danick Briand[2], Nico F. de Rooij[2], Gaetano Mileti[1]

[1] Laboratoire Temps-Fréquence (LTF), Institut de Physique, University of Neuchâtel, Neuchâtel, Switzerland

[2]Institute of Microtechnology (IMT), Sensors, Actuators and Microsystems Laboratory (SAMLAB), Ecole Polytechnique Fédérale de Lausanne (EPFL), Neuchâtel, Switzerland

Email: Gaetano.mileti@unine.ch

We report on the realization and spectroscopic evaluation of a micro-fabricated Rb vapour cell equipped with an anti-relaxation wall coating, in view of applications in miniaturized atomic devices such as atomic clocks, magnetometers, and others.

The micro-fabricated cell features two distinct chambers, realized by KOH etching of two Si wafers that are anodically bonded to two glass wafers serving as optical windows. The two chambers (termed reservoir chamber and interrogation chamber) are linked by a narrow channel. These preforms are coated with octadecyltrichlorosilane (OTS) serving as anti-relaxation coating material, and metallic Rb is dispensed into the reservoir chamber. Finally, the two preforms are sealed together using low-temperature thin-film indium bonding[1] at a temperature of 140°C, sufficiently low such as not to degrade the coating.

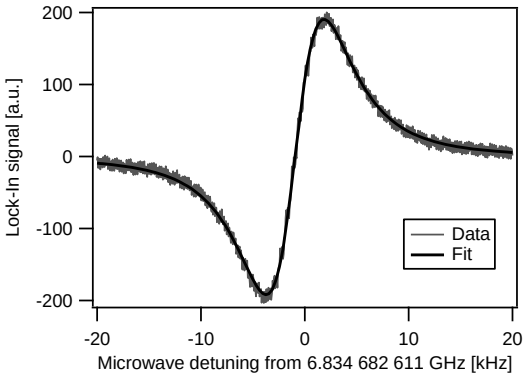

Fig. 1: Narrow double-resonance clock signal observed in the micro-fabricated wall-coated Rb cell.

The produced cell was evaluated by using linear and saturated-absorption spectroscopy, as well as laser-microwave double-resonance (DR) spectroscopy as evaluation tools. The linear absorption spectroscopy shows presence of metallic Rb in both cell chambers. By placing the cell in a microwave resonator, narrow (≈ 9 kHz) DR signals of the ^{87}Rb clock transition could be observed in the interrogation chamber, see Fig. 1. By combining different spectroscopic results, we can exclude a hypothetical buffer-gas contamination of the cell as cause of the narrow DR signals observed and thus conclude that the narrow DR signal linewidth is due to the anti-relaxation wall-coating present in the cell. The DR signal properties relevant for clock operation were studied as a function of laser intensity and microwave power and will be discussed at the conference.

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[1] R. Straessle et al., "Low-temperature indium-bonded alkali vapor-cells for chip-scale atomic clocks", Journal of Applied Physics 113, 064501 (2013).

* R. S. is now with Sensirion AG, 8369 Stäfa, Switzerland. Y. P. is with CSEM SA, 2000 Neuchâtel, Switzerland.