MEMS vapor cells with new geometries for quantum memories

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The feasibility of scalable microfabricated vapor cells for quantum memories in quantum network applications has already been demonstrated. However, the current lifetime and internal efficiency of these memories are constrained by the short spin-polarization lifetime and the dimensions of the Rb-cavities [1]. Here, we demonstrate a Rb vapor cell with a long in-plane light path with square cross section for quantum memories. The cells are made by KOH etching from the top to make the side mirrors, and dry etching from the bottom to make the cavity. There are two compartments for dispensing the Rb source, either in form of RbN_3 or as Rb pills, and a getter element to regulate the Nitrogen gas within the cavity. The Rb vapor will diffuse into the cavity through a channel in the top glass wafer. To improve the reflectivity of the side mirrors, the whole wafer is coated with Aluminium. The spin-polarization lifetime will be further improved by Octadecyltrichlorosilane (OTS) coating inside the cavities [2].

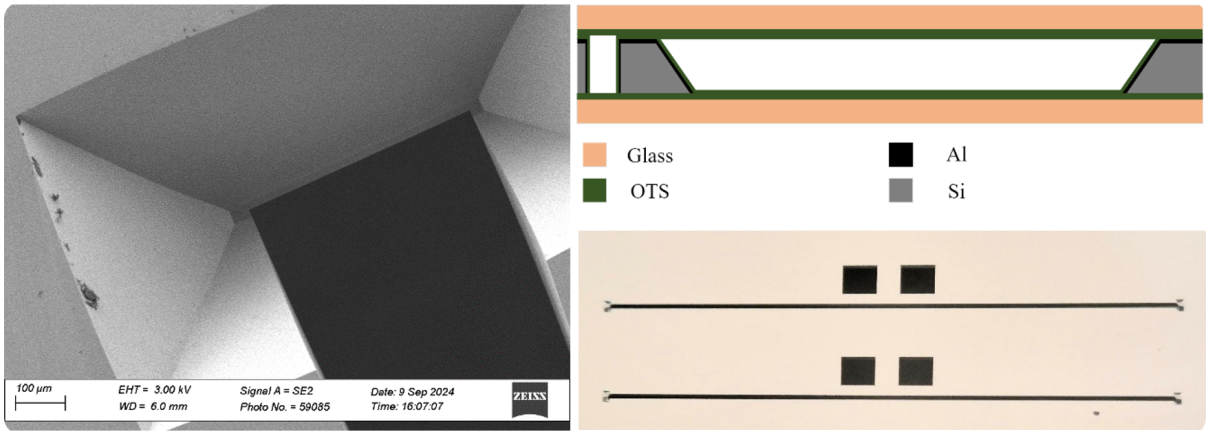

Figure 1. Rubidium vapor cavities fabricated in silicon. Left: SEM measurement of the side mirrors. Top right: Schematic of the cavity and the cover glass wafers. Bottom right: Image of the cavities in a silicon wafer. The cavities are 5 cm in length, and the compartments are reserved for the Rb source and a getter material.

[1] Mottola, R., Buser, G. & Treutlein, P., Optical Memory in a Microfabricated Rubidium Vapor Cell. Physical Review Letters, **131(26)**, (2023).
[2] Seltzer, S. J. & Romalis, M. V., High-temperature alkali vapor cells with antirelaxation surface coatings, Journal Of Applied Physics **106(11)** (2009).