A novel alkali vapor microcell architecture for miniature atomic clocks

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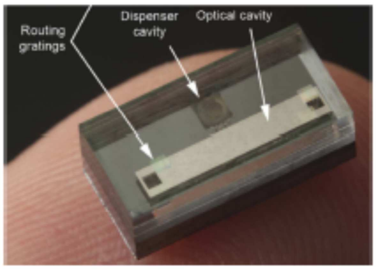
Numerous efforts in different laboratories and companies have been accomplished towards the development of miniature atomic clocks [1,2]. The heart of a MAC is a microfabricated alkali vapor cell, generally filled with a pressure of buffer gas. In FEMTO-ST, we have proposed an original microcell technology in which the Cs vapor is generated after complete sealing of the cell using laser activation of a Cs pill dispenser [3]. This technology is now well-mature and started an industrial transfer process.
In the same time, we met in past projects some potential issues towards an easy and comfortable assembling and alignment of respective components (VCSEL laser, microcell, optics, etc.) of a complete MAC physics package.
In that sense, we report in this work a new and original architecture of microfabricated alkali vapor cell designed for miniature atomic clocks. The Cs filling procedure is still based on laser activation of a Cs pill dispenser. The cell combines diffraction gratings with anisotropically etched single crystalline silicon sidewalls to route a normally-incident beam in a cavity oriented along the substrate plane. Gratings have been specifically designed to diffract circularly polarized light in the first order, the latter having an angle of diffraction matching the (111) sidewalls orientation. The length of the cavity where light interacts with alkali atoms can be extended. As the cavity depth and the beam diameter are reduced, collimation can be performed in a tighter space. This solution relaxes the constraints on the device packaging and is suitable for wafer-level assembly. Several cells have been fabricated and characterized in a clock setup using coherent population trapping spectroscopy. The measured signals exhibit null power linewidths down to 2.23 kHz and high transmission contrasts [4]. Further tests are under progress to characterize the potential of this cell technology. Latest results will be reported at the conference.



References

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