Alkali-filled microcells production and characterization at INRIM

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Emerging application needs in sectors such as telecommunications, avionics, satellite positioning systems and medicine require the development of portable reference devices [1-2]. In this regard, micro-fabricated atomic vapor cells are recognized as an asset to build a new generation of compact, transportable and low-power frequency standards and sensing devices [3-5].
The most consolidated geometric configuration of the micro-fabricated atomic vapor cells relies on the anodically bonded three-layers structure glass-silicon-glass, where the layered arrangement ensures that the activation of the precursor takes place in an isolated environment from the external atmosphere, guaranteeing the stability of the physical package.
The design of the silicon wafer involves the creation, by highly reactive ion etch (DRIE plasma etch), of numerous pairs of passing cavities (Fig. 1). The cavities pairs are connected by microchannels when the alkali atom precursor consists of pills that are activated afterwards the second anodic bonding by a high-power laser around 1000 nm. On the other way around, when the alkali metal (Me) is provided by in-situ reaction from solution dispensing containing BaN6 and MeCl the cavities pairs are not connected by microchannels; in this case, the alkali metal condenses on the on the upper glass that is later shifted to match the "optical cavity" and thus anodically bonded.
At INRIM laboratories, thanks to the recently established clean-room facility [6], we are setting up new research lines involving the production and the characterization of MEMS-like cells filled with rubidium. A few batches have already been produced in-house with the two filling methods described above. In parallel, a characterization setup to perform spectroscopy at the Rb wavelength has been installed, and automation is under way both to characterize the serial production and to activate the precursor pills. Details on the wafer production, yield and evolution of the spectroscopic signals of the cells over the first few months after activation will be presented at the poster.

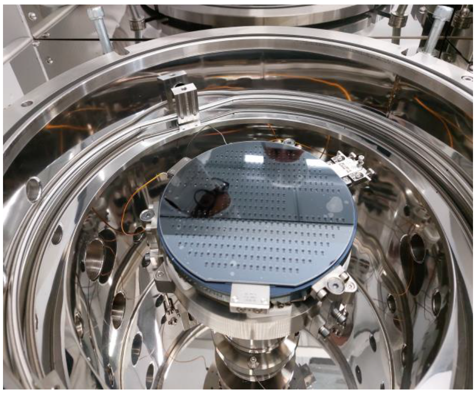

Figure 1. Picture of a wafer produced in one of the first batches placed inside the wafer bonder. Reservoir cavities and optical cavities that are patterned into the silicon preform are visible on the wafer surface.

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