Dispensing and Hermetic Sealing Rb in a Miniature Reference Cell for Integrated Atomic Clocks

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Introduction
The development of the reference cell for a miniature atomic clock presents the following issues:

✓ It must be very small (12*10*2 mm);
✓ It must be filled with an alkali metal (Rb or Cs);
✓ It must be hermetic.

New techniques have been developed for:
✓ Safely handle and store Rb
✓ Fabricate cells in an industrial, repeatable way, using low-temperature solder technique.

New technique: Rb handling & storage
Rb is stored inside a pool of dodecane which protects it from oxidation, and easily dispensed in the cell using a micropipette:

New technique: fabbrication of cells
The realized cells are made of glass, and have dimensions of 12*10*2 mm:

Procedure to fabricate the cell:
1. Screen-printing a first layer of thick film metallisation;
2. Screen-printing of the solder paste on top of the metallisation layer and reflow;
3. Thorough cleaning of the solder flux;
4. Dispensing Rb onto the trapezoidal silver pads;
5. Precise alignment of top and bottom walls;
6. Heating of the cell in vacuum to realize the sealing.

Results
FTIR trasmission of the cell sealed with 30 mbar of N2O gas. After calibration with a pressure sensor, it was found out that 30 mbar of pressure corresponds to a peak of magnitude 0.2

Sealed glass cell with Rb inside: the Rb looks silver in colour, hence it is not oxidized

Conclusions & future steps
Promising results were obtained, but improvements are needed:
• an LTCC spacer will be added to integrate with the cells important functions (pressure sensor, Rb reservoir);
• Long-term interaction between Rb and solder still have to be deeply studied.