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:

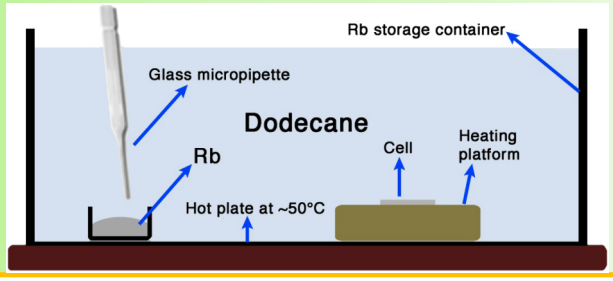
- ✓ It must be very small (12*10*2 mm) ;
- ✓ It must be filled with an alkali metal (Rb or Cs);
- ✓ It must be hermetic.

New techniques have been developed for:

- ✓ Safely handle and store Rb
- ✓ Fabbricate cells in an industrial, repeteable way, using low-temperature solder technique.

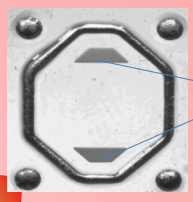
New technique: Rb handling & storage

Rb is stored inside a pool of dodecane which protects it from oxydation, and easily dispensed in the cell using a micropipette:

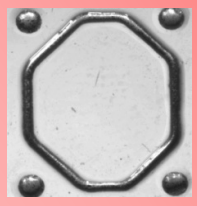


New technique: fabbrication of cells

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



Bottom of the cell

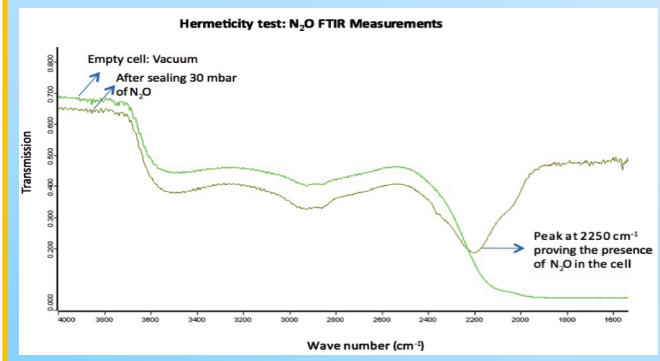


Top of the cell (cap)

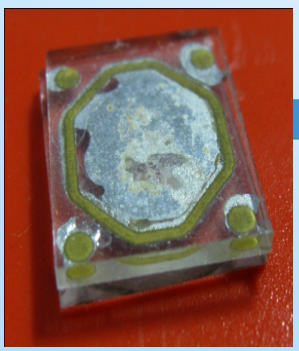
Procedure to fabbricate the cell:

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 oxydized

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.