Integration of wafer-scale Rb vapour cells for saturated absorption spectroscopy laser reference

Charikleia Troullinou[1], Adam Selyem[1], Jack Thomas[1], Ben D. G. Steele[2], William Dorward[3], Rachel Elvin[1], Loyd McKnight[1]

[1] Fraunhofer Centre for Applied Photonics, Technology and Innovation Centre, 99 George Street, Glasgow, UK
[2] INEX Microtechnology Ltd., Herschel Annex, Kings Road Newcastle, UK
[3] Alter Technology Tüv Nord UK Ltd., Livingston, UK

Alkali vapour cells are critical components in many quantum technologies including for magnetometers, clocks and gyroscopes. However, most existing technologies rely on large glass cells which are not suitable for scalable manufacture and have limitations in the way in which they can be used. Inex Microtechnology have developed a wafer-scale rubidium vapour cell to address this challenge. As a proof-of-principle demonstration we have constructed a compact monolithic pump-probe spectroscopy system which offers a reduction in size, weight and power compared to standard approaches. The cell with a path length of only 2 mm provides equivalent spectroscopy signal to a 70 mm long cell if held at a modest temperature of 40 °C. The unit has no free space elements which makes it tolerant to vibrations. In collaboration with Alter Technology, we additionally contributed to the development of a compact, frequency-stabilised laser module with integrated vapour cell that allows locking to spectral features of an atomic reference. The system provides a robust miniaturized light source, ideal for quantum sensing applications.

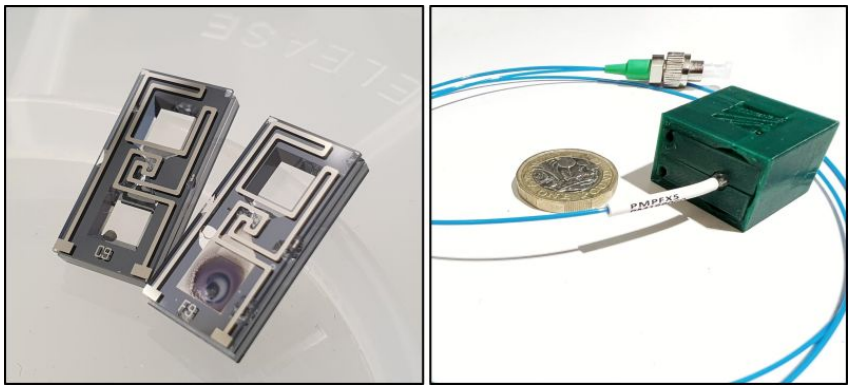

Figure 1. Left: INEX Rb reference cells, Right: Compact monolithic spectroscopy system.

[1] Jack W. Thomas, Ben D. G. Steele, Rachel Elvin, Adam Selyem, and Loyd J. McKnight, A robust micro-integrated rubidium saturated absorption spectroscopy laser reference, Proc. SPIE PC12895, Quantum Sensing and Nano Electronics and Photonics XX, **PC128950V** (2024).