

## MULTI-GAS SENSOR FOR FLEXIBLE OIL RISERS BASED ON QEPAS TECHNOLOGY

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Flexible oil/gas risers are multilayer pipe structures, with a plastic inner (fluid isolation) layer and metal outer layers providing the required strength capacity. The plastic layer is partially permeable for gas constituents, and these gases affect the corrosion rate of the metal layers. Continuous monitoring of the inter-layer gas composition will allow accurate predictions of the riser lifetime, extending the period between costly replacements.

Quartz enhanced photoacoustic spectroscopy [1] with near-infrared fiber coupled diode lasers was used as the basic technology for a multi-gas sensor. The advantages of this approach are: small size of the fiber coupled sensing module (spectraphone, Fig. 2), ready availability of the spectroscopic laser sources (DFB diode lasers), and high immunity to acoustic noise allowing long averaging times for enhanced sensitivity. The current sensor configuration incorporates two lasers, one MEMS based optical switch, and one spectraphone for detection of H<sub>2</sub>S, CH<sub>4</sub>, and CO<sub>2</sub>, as well as miniature temperature, pressure, and humidity sensors. The achieved sensitivities, potential technological issues, and cross-influence of the species at high concentrations due to V-T relaxation effects and the speed of sound variation will be reported.

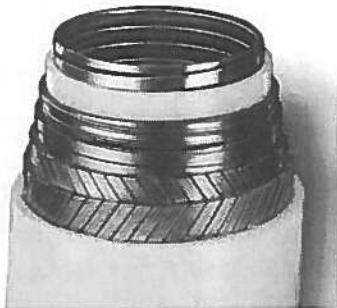


Fig. 1. Example structure of a flexible oil riser.

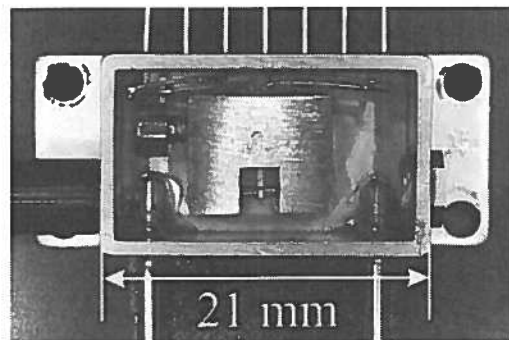


Fig. 2. Alignment-free fiber coupled QEPAS spectraphone.

### References:

- [1] A. A. Kosterev, Y. A. Bakhirkin, R. F. Curl, and F. K. Tittel, *Optics Letters* **27**, 1902-1904 (2002).
- [2] A. A. Kosterev, F. K. Tittel, D. Serebryakov, A. Malinovsky and I. Morozov, *Rev. Sci. Instr.* **76**, 043105 (2005).