

Down memory lane with Frank Tittel

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**Fluorescence Spectrum of Chlorine Dioxide Induced
by the 4765 Å Argon-ion Laser Line¹**

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A few years and papers later

Magnetic Rotation

Sensitivity Enhancement of Laser Absorption Spectroscopy by Magnetic Rotation Effect. G. Litfin, C. R. Pollock, R. F. Curl, Jr., and F. K. Tittel, *J. Chem. Phys.* **72**, 6602-6605 (1980).

Rafał Lewicki, James H. Doty III, Robert F. Curl, Frank K. Tittel, and Gerard Wysocki, "Ultrasensitive detection of nitric oxide at 5.33 μm by using external cavity quantum cascade laser-based Faraday rotation spectroscopy," *Proc Natl. Acad. Sci.* **106**, 12587-12592 (2009).

Christian A. Zaugg, Rafał Lewicki, Tim Day, Robert F. Curl, Frank K. Tittel, "Faraday rotation spectroscopy of nitrogen dioxide based on a widely tunable external cavity quantum cascade laser." *Proc. of SPIE* **7945**: 500-1 (2011).

Tone-burst modulation

Sensitivity improvement of tone-burst modulated spectroscopy with a color center laser. Horst Adams, Jeffrey L. Hall, R. F. Curl, J. V. V. Kasper, and F. K. Tittel, *J. Opt. Soc. Am. B*, **1**, 710-714 (1984).

Trace gas monitoring

Using difference frequency mid-IR generation

Detection of Methane in Air Using a Diode-Laser-Pumped Difference-Frequency Generation Near 3.2 μm . K. P. Petrov, S. Waltman, U. Simon, R. F. Curl, F. K. Tittel, E. J. Dlugokencky, and L. Hollberg, *Appl. Phys B* **61**, 553-558, (1995).

Detection of CO in Air Using Diode-pumped 4.6 μm Difference Frequency generation in Quasi-Phase-Matched LiNbO₃. K. P. Petrov, L. Goldberg, W. K. Burns, R. F. Curl, and F. K. Tittel, *Opt. Lett.* **21**, 86-88 (1996).

Compact mid-infrared trace gas sensor based on difference-frequency generation of two diode lasers in periodically poled LiNbO₃, D. Richter, D.G. Lancaster, R.F. Curl, W. Neu, F.K. Tittel, *Appl Phys B* **67**, 347-350 (1998)

Atmospheric formaldehyde monitoring in the greater Houston area in 2002, J. H. Chen, S. So, H. S. Lee, M. P. Fraser, R. F. Curl, T. Harman, and F. K. Tittel, *Applied Spectroscopy* **58**, 243 (2004).

Quartz tuning fork photoacoustic

Quartz-enhanced photoacoustic spectroscopy, A.A. Kosterev, Yu.A. Bakhirkin, R.F. Curl, and F.K. Tittel, *Optics Letters* **27**, 1902-1904 (2002).

Quantum Cascade Lasers

A. A. Kosterev, R. F. Curl, F. K. Tittel, C. Gmachl, F. Capasso, D. Sivco, J. N. Baillargeon, A. L. Hutchinson, A. Y. Cho, "Methane concentration and isotopic composition measurements with a mid-infrared quantum-cascade laser." *Optics Letters* 24: 1762-1764 (1999).

Review

Robert F. Curl, Federico Capasso, Claire Gmachl, Anatoliy A. Kosterev, Barry McManus, Rafał Lewicki, Michael Pusharsky, Gerard Wysocki, Frank K. Tittel, "Quantum cascade lasers in chemical physics," *Chem. Phys. Lett.* **487**, 1-18 (2010).

Thank you Frank
for 45 years of friendship

1971 to 2016
and counting