

THERMOMETRY OF A DIFFUSION FLAME OF DECANE BY CARS SPECTROSCOPY

V. D. Kobtsev, S. A. Kostritsa, V. V. Smirnov, A. M. Starik, O. M. Stel'makh,
and A. A. Tumanov

P. I. Baranov Central Institute of Aviation Motors, 2 Aviamotornaya Str., Moscow 111116,
Russian Federation

Abstract: In a burner of a diffusion type a detailed two-dimensional distribution of the flame temperature in a vapor–gas mixture of $C_{10}H_{22}$ and N_2 with O_2 along the flame axis as well as in the transversal direction were measured. The temperatures have been determined on the basis of the CARS (coherent anti-Stokes Raman scattering spectroscopy) spectra of nitrogen molecules. The accuracy of temperature measurements was $\sim 3\%$. The maximum measured temperature in the flame front was 2200 K. The spatial resolution of temperature in the directions normal to the axis of the laser beam was $80 \mu m$.

Keywords: CARS thermometry; diffusion flame; local temperature measurement

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References

1. Eckbreth, A. C. 1978. BOXCARS: Crossed-beam phase-matched CARS generation in gases. *Appl. Phys. Lett.* 32:421–423.
2. Rosasko, G. J., W. Lempert, W. S. Hurst, and A. Fein. 1983. Line interference effects in the vibrational Q-branch spectra of N_2 and CO. *Chem. Phys. Lett.* 97(4):435–440.
3. Lavorel, B., G. Millot, R. Saint-Loup, *et al.* 1986. Rotational collisional line broadening at high temperatures in the N_2 fundamental Q-branch studied with stimulated Raman spectroscopy. *J. de Physique* 47(3):417–425.
4. Greenhalgh, D. A. 1988. *Advances in nonlinear spectroscopy*. Eds. R. J. H. Clark and R. E. Hester. Chichester: John Wiley & Sons. 15:193–251.
5. Vereschagin, K. A., V. V. Smirnov, O. M. Stelmakh, *et al.* 2001. Temperature measurements by CARS in hydrogen-fuelled scramjet combustor. *Aerosp. Sci. Technol.* 5(5):347–355.
6. Grisch, F., P. Bouchardy, L. Vingert, *et al.* 2004. CARS measurements at high pressure in cryogenic LOx/GH₂ jet flames. *Liquid rocket thrust chambers: Aspects of modeling, analysis, and design*. Eds. V. Yang, M. Habiballah, M. Popp, and J. Hulka. Progress in astronautics and aeronautics ser. AIAA. 200:369–404.

7. Kobtsev, V. D., D. N. Kozlov, S. A. Kostritsa, V. V. Smirnov, and O. M. Stel'makh. 2015. Temperature fluctuations in turbulent flame measured using coherent antiStokes Raman scattering. *Tech. Phys. Lett.* 41(8):756–758. doi: 10.1134/S106378501508012X.
8. Kobtsev, V. D., D. N. Kozlov, S. A. Kostritsa, V. V. Smirnov, O. M. Stel'makh, and A. A. Tumanov. 2016. Lazernyy spektrometricheskiy izmeritel'nyy kompleks dlya lokal'noy ekspress-dagnostiki plameni pri gorenii zhidkikh uglevodorodnykh topliv [Laser spectrometric measurement system for local express-diagnostics of flame at combustion of liquid hydrocarbon fuels]. *Optika i Spektroskopiya* 120(2):138–145.

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Contributors

Kobtsev Vitaly D. (b. 1989) — engineer, P. I. Baranov Central Institute of Aviation Motors, 2 Aviamotornaya Str., Moscow 111116, Russian Federation; kobtsev.vitaly@gmail.com

Kostritsa Sergey A. (b. 1956) — research scientist, P. I. Baranov Central Institute of Aviation Motors, 2 Aviamotornaya Str., Moscow 111116, Russian Federation; kostritsa@ciam.ru

Smirnov Valery V. (b. 1944) — Doctor of Science in physics and mathematics, Head of Department, P. I. Baranov Central Institute of Aviation Motors, 2 Aviamotornaya Str., Moscow 111116, Russian Federation; vvs@ciam.ru

Starik Alexander M. (b. 1950) — Doctor of Science in physics and mathematics, Head of Division, P. I. Baranov Central Institute of Aviation Motors, 2 Aviamotornaya Str., Moscow 111116, Russian Federation; star@ciam.ru

Stel'makh Oleg M. (b. 1945) — Candidate of Science in physics and mathematics, head of sector, P. I. Baranov Central Institute of Aviation Motors, 2 Aviamotornaya Str., Moscow 111116, Russian Federation; stelmakh@kapella.gpi.ru

Tumanov Alexander A. (b. 1989) — engineer, P. I. Baranov Central Institute of Aviation Motors, 2 Aviamotornaya Str., Moscow 111116, Russian Federation; sashkatu@gmail.com