APPLICATION OF THE ABSORPTION SPECTROMETRY METHOD TO STUDY THE HIGH-TEMPERATURE OXIDATION OF DIETHYL ETHER

N. S. Bystrov[1], A. V. Emelianov[1], E. S. Kurbatova[1,2], and P. I. Yatsenko[1,3]

[1]Joint Institute for High Temperatures of the Russian Academy of Sciences, 13, bld. 2 Izhorskaya Str., Moscow 125412, Russian Federation

[2]Moscow Institute of Physics and Technology, 9 Institutskiy Lane, Dolgoprudny, Moscow Region 141701, Russian Federation

[3]Bauman Moscow State Technical University, 5 Baumanskaya 2nd Str., Moscow 105005, Russian Federation

Abstract: The work presents experimental study of diethyl ether (DEE, $C_2H_5OC_2H_5$) high-temperature oxidation because DEE is considered as a promising component of synthetic fuel mixtures. All experiments were carried out behind reflected shock waves at temperatures of 900–3400 K and pressures of 1.7– 3.7 bar. O_2 was used as an oxidizer, the initial composition of the mixture was 5 ppm DEE + 30 ppm O_2 + Ar. The time-resolved absorption profiles of atomic oxygen were measured via atomic resonance absorption spectrometry at a wavelength of 130.5 nm. These profiles were then transformed into the corresponding concentration profiles. These experimental results obtained for the first time are a valuable data set for validation and further improvement of kinetic models. The presented data were modeled using modern kinetic schemes of DEE combustion. The temperature dependent discrepancy between the calculated results and the experimental ones were also shown.

Keywords: diethyl ether; oxidation; atomic resonance absorption spectrometry; shock waves; kinetic modeling

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Figure Captions

Figure 1 Typical experimental oscillogram, mixture — 5 ppm DEE + 30 ppm O_2 + Ar, parameters behind reflected shock wave — $T = 2069$ K and $p = 2.6$ bar; *1* — absorption signal; *2* — pressure signal; and *3* — initial light intensity I_0

Figure 2 Time-resolved concentration profiles of O-atoms experimentally obtained in mixture of 5 ppm DEE+30 ppm O_2+Ar: *1* — $T = 1352$ K, $p = 3.1$ bar; *2* — $T = 1682$ K, $p = 2.9$ bar; *3* — $T = 1905$ K, $p = 2.6$ bar; *4* — $T = 2069$ K, $p = 2.6$ bar; *5* — $T = 2344$ K, $p = 2.5$ bar; *6* — $T = 2532$ K, $p = 2.4$ bar; *7* — $T = 2704$ K, $p = 2.2$ bar; *8* — $T = 2958$ K, $p = 2.1$ bar; *9* — $T = 3024$ K, $p = 1.9$ bar; *10* — $T = 3253$ K, $p = 1.9$ bar; and *11* — $T = 3432$ K, $p = 1.8$ bar

Figure 3 Experimental (*1*) and calculated (*2* — [12]; *3* — [11]; *4* — [7]; *5* — [20]; *6* — [13]; and *7* — [9]) concentration profiles which are typical for three temperature ranges: low temperatures — (*a*) $T = 1515$ K and $p = 2.9$ bar, (*b*) $T = 1825$ K and $p = 2.8$ bar; intermediate temperatures — (*c*) $T = 2237$ K and $p = 2.5$ bar, (*d*) $T = 2532$ K and $p = 2.4$ bar; and high temperatures — (*e*) $T = 2822$ K and $p = 2.1$ bar, (*f*) $T = 3253$ K and $p = 1.9$ bar

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Contributors

Bystrov Nikita S. (b. 1995) — Candidate of Science in physics and mathematics, senior research scientist, Joint Institute for High Temperatures of the Russian Academy of Sciences, 13, bld. 2 Izhorskaya Str., Moscow 125412, Russian Federation; bystrovns.jiht@gmail.com

Emelianov Alexander V. (b. 1959) — Candidate of Science in physics and mathematics, senior research scientist, Joint Institute for High Temperatures of the Russian Academy of Sciences, 13, bld. 2 Izhorskaya Str., Moscow 125412, Russian Federation; aemelia@ihed.ras.ru

Kurbatova Elizaveta S. (b. 2002) — trainee researcher, Joint Institute for High Temperatures of the Russian Academy of Sciences, 13, bld. 2 Izhorskaya Str., Moscow 125412, Russian Federation; magister student, Moscow Institute of Physics and Technology, 9 Institutskiy Lane, Dolgoprudny, Moscow Region 141701, Russian Federation; kurbatova.lz@yandex.ru

Yatsenko Pavel I. (b. 1993) — Candidate of Science in physics and mathematics, senior research scientist, Joint Institute for High Temperatures of the Russian Academy of Sciences, 13, bld. 2 Izhorskaya Str., Moscow 125412, Russian Federation; associate professor, Bauman Moscow State Technical University, 5 Baumanskaya 2nd Str., Moscow 105005, Russian Federation; pavelyatcenko@yandex.ru