Application of atomic resonance absorption spectroscopy on the oxygen atoms in chemical kinetics of high temperature reactions

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The formation of atomic oxygen occurs in most hydrocarbon and biofuel combustion processes. Various kinetic schemes make it possible to quantitatively calculate the appearance and consumption of atomic oxygen during combustion and pyrolysis processes. However, the verification of these models is based on accurate experimental data obtained under various conditions. The method of atomic resonance absorption spectroscopy (ARAS), as the gold standard of chemical kinetics, makes it possible to directly and reliably measure the concentration of atomic oxygen with the possible range of the measured concentration within 3×10^{11} to 10^{14} cm^3. As a result the rate constants of the reactions of various oxygen-containing compounds can be directly determined. The presented work shows the development of the use of O-ARAS method in shock tubes, starting from the dissociation reactions of simple molecules to the reactions of pyrolysis and combustion of complex alcohol compounds at 1200–2500 K and 2–4 bar. The possibilities of using high-power excimer lasers at a wavelength of 193 nm (500 mW per pulse) for photolysis of simple oxygen compounds with the immediate formation of atomic oxygen at the variable time after arrival of a reflected shock wave for studying combustion processes of various substances at 500–1200 K are discussed. The reported study was funded by the Russian Foundation for Basic Research (grant No. 20-58-12003).