Kinetics of the formation of O atoms under pulse laser exposure on a mixture of O_2 and Ar behind reflected shock waves

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Atomic oxygen is one of the main combustion radicals, so information about its concentration is extremely important in any combustion process of hydrocarbon and biofuels. At present, various kinetic schemes make it possible to accurately calculate the appearance and consumption of atomic oxygen in medium- and high-temperature combustion processes. However, at low temperatures, testing the predictive ability of models to describe different concentration profiles is difficult due to the limited availability of accurate experimental data. One of the most reliable instruments for experimental studies of chemical kinetics is the shock tube. The combining a shock tube with the pulse laser photolysis significantly expands the temperature range of experimental studies. This paper presents the first experimental results of measuring atomic oxygen concentrations using the method of atomic resonance absorption spectroscopy (ARAS), obtained by flash photolysis using an ArF laser (193 nm) of vibrationally excited oxygen molecules thermally heated behind the reflected shock wave. Experimental dependences of the concentration of atomic oxygen O(3P) on the concentration of O_2 at temperatures of 700–1500 K behind the reflected shock waves and laser pulse energy of 300–400 mJ were obtained. Besides that the yield of O atoms was numerically calculated at different temperatures, concentrations of O_2 molecules, and laser pulse energies. A comparison of the experimental data with the kinetics of the formation and consumption of oxygen atoms was carried out.