The phenomenon of chemical ionization in flames, that is, the formation of ions via chemical reactions between electroneutral substances, was discovered in the late 1940s. The electrical nature of flames has long been realized. The high levels of ions of non-thermal origin in the reaction zone of flames was an evidence of chemi-ionization. It was experimentally demonstrated that a hydrocarbon fuel was needed for chemical ionization, and shock tube experiments have additionally demonstrated that oxygen should be present. Consequently, it was accepted that HCO+ was the major primary ion. At the same time, there is an obvious lack of kinetic data obtained in shock tubes under conditions such that there are no problems arising from complicated gas dynamics, transfer limitations, or temperature gradients. These data are needed to establish systematic correlations between combustion and ionization, which are expected to be of great practical significance. However, use of shock wave techniques is also impeded by the absence of diagnostic methods for studying ionization kinetics. The choice of methods applicable to kinetic studies in shock waves is quite limited.

This work presents the results of measurements of the concentration of free electrons by a microwave interferometer and by an electric probe during the oxidation of acetylene and methane mixtures behind reflected shock waves. The detailed kinetic model of chemical ionization was constructed based on soot formation kinetic model. The results of detailed kinetic modeling are in good agreement with the experimental data.

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