Thermal accommodation coefficient of soot particles formed under different conditions

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In this study, the thermal accommodation coefficient (α) of surrounding gas molecules on soot particles surface was measured. It is an important parameter that characterizes the particle cooling rate and is meant for use in models of laser-induced incandescence (LII) of soot. The thermal accommodation coefficient of soot particles was studied in wide range of synthesis conditions (such as reactor type, chemical composition of the mixture, residence time, etc.) to found dependence of α on these parameters. Soot particles were synthesized by ethylene, acetylene and propylene combustion in a flat premixed flame and by pyrolysis of the same hydrocarbons in a shock tube at temperatures of 1800–2000 K and a pressure of 3–4 atm. Experimental diagnostics include the measurements of LII signals of soot particles with a nanosecond laser pulse and sampling for transmission electron microscopy. In results, the dependence of α on soot primary particle size was obtained. Since the accommodation coefficients relate to different surrounding gases, their values are stratified, respectively, for argon (in a shock tube) and flame gases (burner). However, both of these dependences show an increase in the accommodation coefficient with the soot particles size in the range of 10-25 nm. For Ar, α increases from 0.45 to 0.55 and does not depend on the type of hydrocarbon. For flame gases, α increases from 0.15 to 0.35 and are affected by the type of hydrocarbon. The obtained results are in a good agreement with literary data.