Optical properties of soot synthesized in pyrolysis of ethylene and acetylene in shock tube reactor

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In this study, shock tube pyrolysis of 5% ethylene and 3% acetylene in argon was used to study the process of soot formation and properties of formed particles. The measurements of soot optical properties were performed at the temperatures behind reflected shock waves 1800-2000 K, corresponding to a maximum soot yield. The reaction time of the soot yield 1.5 ms within operation time of the shock tube was chosen due to at this time soot volume fraction reaches the plateau. The absolute value of the refractive index function of soot $E(m, 1064)$ at a wavelength 1064 nm and the ratio of the refractive index functions at two wavelengths of 532 nm and 1064 nm were measured by laser induced incandescence. The $E(m, 1064)$ was found to be 0.44 for acetylene soot and 0.35 for ethylene soot by comparing the measured peak temperature of laser heated soot with the calculated peak temperature obtained using laser induced-incandescence model. The ratio $E(m, 1064)/E(m, 532)$ was found to be 1.28 for acetylene and 0.8 for ethylene soot. The samples of soot nanoparticles were analyzed using high resolution transmission electron microscopy to determine the mean soot primary particle size and internal soot structure. The investigated optical and structural properties of shock tube pyrolysis soot were compared with the properties of acetylene and ethylene flame soot at corresponding mean soot particle sizes. A good correlation between the properties of pyrolysis and flame soot was obtained. This study was funded by Russian Science Foundation, project 19-79-10204.