# Optical properties of soot formed under different conditions. Application to the effects of soot on climate.

A.V. Drakon[1], A.V. Eremin[1], E.V. Gurentsov[1], E.S. Khodyko[1,2] and R.N. Kolotushkin[1]

[1] Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia

[2] Bauman Moscow State Technical University, 2nd Baumanskaya Street 5, Moscow 105005, Russia

kolotushkin.roman@gmail.com

Soot particles appearing due to human activity are known to play important role in Earth's climate system. Soot (black carbon) is a distinct type of carbonaceous material with unique combination of physical properties. The soot aerosol in atmosphere absorbs incoming solar radiation and scatters it. Soot deposition on glaciers causes surface dimming and melting. It reduces snow albedo, causing more solar radiation to be absorbed. These factors lead to atmospheric warming and global temperature increase [1].

An accurate data of soot optical properties is necessary for reliable estimates of climate models. However, a wide variation of soot properties is observed in dependence on formation conditions. In this study, soot nanoparticles 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. The absolute value of the refractive index functions of soot nanoparticles E(m,1064) at wavelength 1064 nm, the ratio of the refractive index functions at two laser wavelengths of 1064 nm and 532 nm were studied in dependence on soot primary particle size. It was found that soot refractive index function increases with soot particle size as decaying exponential function and does not exceed value of 0.55.

Internal structure of soot particles was analyzed by transmission electron microscope to found parameters causing the soot optical properties changes. Such parameter appeared to be interlayer spacing between the graphene fringes in the soot basic structural units. An interlayer spacing decrease is resulted by soot graphitization and soot primary particles growth process.

It was found that optical properties and an extend of soot graphitization is strongly affected by type of hydrocarbons used for synthesis and by the primary particle size. At the same time, it slightly depends on the type of reactor and, consequently, on the temperature and pressure in the investigated range of parameters.

The data obtained in this study can improve climate models by applying the E(m) of soot as a function of particle size instead of constant value.

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**References**

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