Radiative properties of in-flame sooty aggregates from fire scenarios of polymer burning

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Light scattering properties of airborne particles are extensively simulated for atmospheric and combustion research in the literature [1,2]. Remembering that the thermal radiation can be considered as non-polarized electromagnetic waves, the electromagnetic theory is used to compute the thermal radiation interaction with groups of complex shaped objects. One of the numerical methods to solve this interaction is based on the discrete dipole approximation (DDA) theory. The radiative properties of nano- and micrometer-sized systems of multiparticles, such as soot aggregates, can be computed by the DDA. The application of the DDA to the radiative properties of 3D tomography of soot from controlled combustion were previously presented [3]. In this study a novel domain of application will be presented: the radiative properties are computed for sooty aggregates extracted from fire scenarios of burning of polymeric materials. Polymeric specimens, formulated as fire resistant/retardant, are ignited with external radiative heating. Aggregates are extracted on TEM grids from fire scenarios. The complex geometries of aggregates and the chemical compositions (such as internal mixing with elements other than black carbon and external coating [4]) are investigated using electron microscopy facilities. Then, the extinction properties are investigated accordingly by means of subsequent numerical simulations using the DDA theory. The resulting properties will be discussed to understand the impact of the complex agglomerates on the generated heat, flame radiation, and on the chemical decomposition pathway of our polymeric specimens during fire scenarios at laboratory scale. The findings are also expected to contribute to atmospheric soot data and aerosol optics from fire emissions.

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References

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