Elucidating optical and chemical characteristics of laser irradiated soot particles

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Abstract

Laser irradiation can induce various physical and chemical changes in soot nanoparticles making them suitable for specific applications in different areas.

In this work, we couple extinction measurements with FT-IR and Raman spectroscopy for a comprehensive understanding of the modifications taking place in soot nanoparticles after laser irradiation, elucidating the optical, chemical, and structural characteristics of the particles under investigation.

Particles are sampled from a premixed flame at two distinct heights above the burner, representing two different aging stages, and sent to an irradiation tube where IR-laser irradiation happens in excess of exhaust gases.

While nascent particles exhibit minimal modification under laser irradiation, we observe significant alterations in absorption properties, inner particle structures, and specific surface functionalities upon heating mature particles with one or ten laser pulses. Additionally, the presence of oxygenated species in mature particles, particularly those spectroscopically correlated with graphene oxide, suggests the occurrence of specific chemical reaction pathways when particles are irradiated in an environment rich in exhaust gases.

The results open up new possibilities for the development of advanced materials with tailored properties, contributing to the advancement of technology and the transition towards a more sustainable and circular economy.

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