EFFECT OF ETHANOL ADDITION ON SOOT PARTICLE FORMATION IN A MINIATURE INVERTED SOOT GENERATOR

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Abstract

The present study is aimed at investigating the effect of ethanol addition on the total amount and the size distribution of soot particles produced by an ethylene flame in a Miniature Inverted Soot Generator (MISG).

The MISG is a combustion-based soot generator working as an inverted flame burner. It allows to obtain a stable generation of soot particles thanks to the stability of its co-flow diffusion flame, that shows a reduced flickering of the flame tip.

Ethanol is one of the most studied and used oxygenated additives and it is chosen as it can be obtained from biomass at reasonable cost. Three different flame conditions are investigated: one of pure ethylene as a reference flame and two with a higher amount of ethanol (10% and 20% with respect to the total carbon fed). The equivalence ratio of the three flames is kept constant at 0.124 to operate the MISG with a partially open-tip flame, leading to a particle size distribution function peaked at less than 100 nm. The analysis of the particle size distribution functions is performed by means of a nano-Differential Mobility Analyzer (nano-DMA) to detect the smaller particles and then integrated by using a Dekati Electrical Low-Pressure Impactor (ELPI). The results exhibit a general reduction of the number concentration of soot particles as a function of the amount of ethanol added to the flame. Moreover, the trend showed by the particle size distributions is the one expected for the MISG partially open-tip flame. Finally, Raman spectroscopy measurements are carried out on the ELPI filter stages to evaluate the effect of ethanol addition on the chemistry of the flame-formed carbon nanoparticles. The resulting Raman spectra show a more intense peak D for the soot particles produced by the ethanol-doped flames, corresponding to a larger size of the aromatic domains.

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