Experimental study of soot formation during ethylene pyrolysis with biofuels

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Linear and cyclic esters (furan (*F*), tetrahydrofuran (*THF*), diethyl (*DEE*) esters, dimethoxymethane (*DMM*)) are of high–potential biofuels representatives. Its production have a "zero carbon footprint", and the presence of oxygen in their composition should lead to an increase in the oxidation processes efficiency, which in turn could reduce the amount of soot nanoparticles formed due to incomplete fuel combustion. In this work the experimental study of the effect of listed biofuel additives on the soot formation processes during ethylene pyrolysis behind reflected shock waves in $p_5 = 2.1$–4.4 atm, $T_5 = 1600$–2580 K range was carried out. Laser extinction at 633 nm was used to measure the condensed phase volume fraction. Soot-particle size was determined by laser induced incandescence (LII) method using a Nd:YAG laser at a wavelength of 1064 nm and by transmission electrons microscopy (TEM) analysis. It was found that the *F* additives resulted in greatly increased soot yield and particle sizes and expanded the temperature range of its formation; the *THF* additives resulted in increased soot yield and particle sizes at $T_5 = 2240$–2500 K; the *DEE* addition led to a shift in the soot formation processes to higher temperatures and slight increase in soot volume fraction; the *DMM* additives demonstrated no effect on soot formed, but increased the soot particle sizes at $T_5 = 2200$–2300 K. Soot sizes measured by LII and TEM are in good agreement. Kinetic reasons of biofuel additives are discussed.

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