Effect of DME on soot formation in acetylene/air flame

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Soot, as a by-product of the combustion of hydrocarbon fuels, has a negative impact on both climate and human health. The addition of dimethyl ether (DME), as an alternative fuel, to the flame is of interest in terms of mitigation of soot yield. In this study, we investigated soot formation in a standard premixed acetylene/air flame with the addition of 0, 5.8 and 15.4% DME. The soot volume fraction, optical band gap and dispersion coefficient were measured using the laser extinction method at wavelengths of 405, 633, 780 and 850 nm. The flame temperature versus height above the burner was measured using thermocouples of types 'B' and 'K'. The average particle size at the height above burner of 19 mm was measured from the analysis of transmission electron microscopy (TEM) images for different fuel mixtures. Kinetic modeling of soot particles was also carried out based on the kinetic mechanisms developed by the CRECK group.

It has been shown that the addition of 5.8% DME has no significant effect on the soot formation process in an acetylene/air flame, while the addition of 15.4% DME leads to a decrease in the concentration of soot particles and a reduction in the average particle size. At the same time, the decrease in the average particle size is accompanied by a decrease in the absorption of the soot particles and an increase in the optical band gap.

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