

Sooting Flames # 5

Apparatus

Premixed flames of ethylene/oxygen at atmospheric pressure were produced on a commercial McKenna sintered bronze burner (d=60mm). Burner was water-cooled and the temperature of the cooling water was kept constant at 16°C. An external shield of nitrogen was used to avoid air entrainment. Different cold-gas flow velocities and equivalence ratios were used.

Measurements

Flame temperatures were measured along the flame axis with a fast-response thermocouple (silica-coated 25µm Pt/Pt-13%Rh) by using a fast-insertion procedure. A radiation correction procedure was applied to obtain corrected temperature profiles [Ref 5]. The uncertainty of the measured temperatures was estimated to be as high as 100 K.

Soot, condensable species (CS), and gaseous combustion products were isokinetically sampled along the flame axis by using a stainless-steel water-cooled (60°C) probe (i.d. = 2mm) [Ref 2,4].

Species concentrations were sampled in two chromatograph valves with online gas analysis, GC-TCD for small species, GC-FID for C₆ species, and GC-MS for PAH [Ref 2, 5]

Soot and CS were collected on a teflon filter and in a cold trap and extracted by dichloromethane (DCM) to separate the DCM-soluble material (condensed species) from the insoluble solid carbonaceous material (soot). The amount of soot was determined gravimetrically [Ref 2].

H/C ratio of soot was measured by a PerkinElmer 2400 CHNSO elemental analyzer [Ref 7].

Conditions

Pressure 1 bar

I=2.4 (C/O=0.8) – Fuel: 44.4 % - O₂: 55.6 %

- x V₀=2cm/s– Ref2 (mostly) & 4
 - o Temperature profile
 - o Species profiles (C₂H₄, C₂H₂, C₆H₆)– Ref2 & 3
 - o PAH profiles (A2, A2R5, A3, A4, A4R5, FLTN)– Ref3 & 4
 - o Soot profiles

- x V₀=4cm/s– Ref2 (mostly), 4, 5, 6, 7
 - o Temperature profile – Ref2 & 5
 - o Species profiles (C₂H₄, C₂H₂, C₆H₆) – Ref2 & 3
 - o Species profiles (CO,

- o PAH profiles (A2, A2R5, A3, A4, A4R5, FLTN) - Ref 3 & 4
 - o Soot profiles - Ref 2, 5, 7
 - o H/C ratio - Ref 6 & 7
- x $V_0=6\text{cm/s}$ - Ref 2

- o Temperature profile
- o Species profiles (C₂H₄, C₂H₂, C₆H₆) - Ref 2 & 3
- o PAH profiles (A2, A2R5, A3, A4, A4R5, FLTN) - Ref 3
- o Soot profiles

$l=3.0$ (C/O=1.0) - Fuel: 50.0 % - O₂: 50.0 %

- x $V_0=4\text{cm/s}$ - Ref 5

- o Temperature profile
- o Species profiles (CO, CO₂, CH₄, C₂H₂, C₃H₄, C₃H₆, C₄H₂, C₄H₄, C₄H₆, C₅H₆, C₆H₆)
- o Total PAH weight profiles
- o Soot profiles

Notes

Ref 5 lists slightly different equivalence ratios than the other refs, namely $\phi=2.12$ and $l=3.03$ vs. $l=2.4$ and $l=3.0$.

The mole fractions are reported "as measured", that means as "dry values"; the water was removed from sampled gases before the measures.

Some of the species concentrations are given with units of g of the species per ³cat STP conditions (0°C, 10⁵Pa) of sampled gases.

References

1. A. Ciajolo, R. Barbella, A. D'Anna, Combust. Sci. Technol. 100 (1994) 271-278.
2. A. Ciajolo, A. D'Anna, R. Barbella, A. Tregrossi, A. Violi, Proc. Comb. Inst. 26 (1996) 2327-2333
3. A. Ciajolo, A. D'Anna, R. Barbella, A. Tregrossi, ECC profile = 2. Tc 0 j / TT10 1 Tf 3.59053es