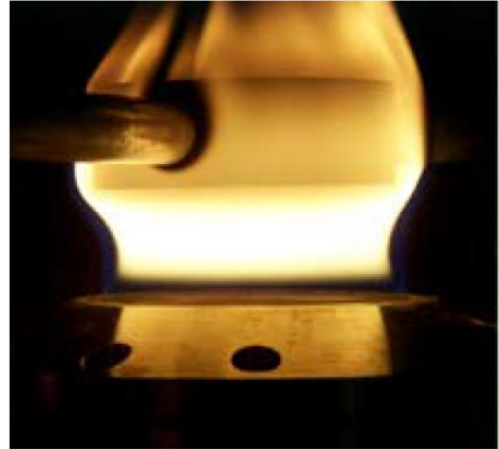


Sooting Flames #3

This burner and stabilization geometry has been proposed as a standard test case for the international workshop on LII. Several groups have investigated it.

Apparatus

The measurements were performed in a premixed flat *ethylene/air* flame. The flame burns on a water-cooled, McKenna burner, which has a sintered bronze plug with a diameter of 60 mm. An outer co-flow of nitrogen shields the flame from room air entrainment. The flame is stabilized with a stainless steel plate (same diameter as burner) located 21 mm above the burner.



Measurements

Gas temperatures were measured using

- vibrational coherent anti-Stokes Raman spectroscopy (CARS). [Ref 2]
- rotational coherent anti-Stokes Raman spectroscopy (CARS). [Ref 2,6]
- a 50 μm Pt/Pt-Rh(10%) uncoated thermocouple and were corrected for heat losses [Ref 8]

Soot volume fraction was measured using

- laser extinction at 3 different wavelengths (532, 632.8, and 1064 nm) with a refractive index of $m=1.56-0.46i$, resulting in an extinction coefficient of $K_e=5.01$ [Ref 1, 4]
- laser extinction at 1064 nm with $K_e=5.46$ [Ref 8]
- 2D Laser Induced Incandescence (LII) at 1064 nm [Ref 5]

Soot particle sizes were measured using

- thermophoretically sampled soot particles analyzed by transmission electron microscopy. [Ref 6]
- three-angle scattering and extinction measurements using the Rayleigh–Debye–Gans theory and a fractal-like description of soot [Ref 7, 8]
- using temporal decay time of the laser-induced incandescence signal [Ref 1]

Conditions

Pressure: 1 bar

Cold gas velocity (at 1atm and 298K): 6.44 cm/s

$\phi=2.1$ (C/O=0.7) – Fuel: 12.8 % - O₂: 18.3 % - N₂: 68.9 %

- Temperature profile – **Ref 6**
- Soot volume fraction – **Ref 1, 4, 5**
- Particle diameter – **Ref 1,6**

$\phi=2.3$ (C/O=0.767) – Fuel: 13.87 % - O₂: 18.09 % - N₂: 68.04 %

- Temperature profile – **Ref 2**
- Soot volume fraction – **Ref 1, 4, 5**
- Particle diameter – **Ref 1**

$\phi=2.34$ (C/O=0.78) – Fuel: 14.0 % - O₂: 18.0 % - N₂: 68.0 %

- Temperature profile – **Ref 8**
- Soot volume fraction – **Ref 8**
- Number density – **Ref 7**
- Radius of gyration – **Ref 8**
- Particle diameter – **Ref 8**

Notes

Only the $\phi=2.1$ is a target for the LII workshop. The other flames are listed here as they are based on the same geometry.

The larger values obtained with laser extinction at 532nm and 632.8nm vs. 1064nm can be explained by non-negligible absorption of PAH.

The studies have been done with either a stainless steel [1,2,4,5] or a bronze burner [6,7,8].

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