Laboratory flame soot characterization during BC^3

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Flame soot sources at Boston College

BC^2

- Premixed ethylene and O₂
- Well-defined combustion zone (ϕ = 2)

BC^3

- Methane and air mix by diffusion
- Stable output, lean flame

What are effects of fuel and combustion conditions on soot chemistry?
Flat burner flame EQ = 2.0

NR-PM ORG ~ 25% of rBC Mass

Cross et al. 2010
inverted flame

- Nascent $m_p = 4.7$ fg
- Denuded $m_p = 4.8$ fg

ORG < 5%?
(Stipe et al., Rev. Sci. Instrum., 2005)
Nope! ORG ~ 22% of rBC mass

Inverted flame soot, $D_m = 350$ nm

- nascent
- denuded

slope = $0.22 \pm 0.01$

int = $-0.06 \pm 0.02$

$r^2 = 0.90$
Laser power drop measurements of inverted flame soot

HRBC and HRORG NORMALIZED to CPC

Inverted flame
- ORG
- rBC

Flat burner flame
- ORG (DOS)
- denuded rBC
- nascent rBC

Normalized vs. Laser Power (mW)
SP-AMS spectra of inverted flame soot

- ‘HOA’-like organics
- More organics than inferred by nascent/denuded CPMA
  - Low volatility - not removed by TD at 270°C
fullerenes in inverted flame soot
rBC “Tim triangle”

- Flat burner data from Onasch et al., AS&T, 2012
Effective density of coated soot

![Graph showing the effective density of coated soot versus [NR-PM]/[rBC]. The x-axis represents [NR-PM]/[rBC] ranging from 0 to 25, and the y-axis represents effective density (g cm$^{-3}$) ranging from 0.0 to 2.0. The data points are color-coded to differentiate between different soot coating materials: red triangles for H$_2$SO$_4$ and green circles for DOS.]