New ISF3 Premixed Flame 6

Premixed Flame 6\*

References:

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Chiara Saggese, Alberto Quoci, Alessio Frassodalti, Sara Ferrario, Joaquin Camacho, Hai Wang, Tiziano Farave

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Aamir D. Abid, Joaquin Camacho, size distribution in premixed flames The burner-stabili 156, 1862 1870 (2009).

Datasheet Table of Contents:

1. References

2. 3D burner dimensions, sampling probe dimensions and flow parameters

3. Absolute PSDF of Premixed Flame 6 measured at 3 separate facilities

4. Number density and volume fraction for Premixed Flame 6 measured at 3 separate facilities

5. Mass classified PSDF to elucidate mass vs. mobility diameter relationship

6. Recommended spatial shifts to the pseudo 1D flame simulation to account for 2D probe effects

## Approach:

Reproduce measurements of mobility PSDF for ISF3-Premixed Flame 6 (burner-stabilized stagnation flames) across 3 Universities (Stanford, Shanghai Jao Tong and Tsinghua) and using a 5cm custom burner, 7.6 cm custom burner and McKenna burner.

Measure the particle mass / mobility size relationship via tandem mobility and mass measurements for nascent soot in ISF3-Premixed Flame 6.

Quantify probe perturbation effects to the assumed pseudo 1D flow field due to the finite flow velocity (deviation from non-slip boundary condition) at the probe orifice. Provide recommended spatial shift to the pseudo 1D numerical solution to account for 2D probe effects.

Recommendation to adopt new ISF3 Premixed Flame 6 data:

As discussed in Camacho 2015, there is excellent agreement in mobility PSDF PSDF PSDF PSDF @ 13/2008 BDD

that the local temperature was lower than expected which would cause soot nucleation to be artificially delayed. The new mobility measurements should be weighted more heavily than those reported in Abid 2009.

The particle mass was measured in tandem to the new mobility measurements, thus the new mobility measurements should be adopted when the mass measurements are considered.

A systematic modeling study was carried out comparing 2D and pseudo 1D models of the burner-stabilized stagnation sampling configuration in terms suction induced 2D perturbations of the flow field. A factorial analysis to quantify the extent of probe perturbation was carried out by considering the parameters which the perturbation is most sensitive to. These parameters are the height above the burner, the pressure drop across the sampling orifice and the flow velocity at the burner boundary. The analysis resulted in suggested spatial shifts to be applied to the numerical solution of the pseudo 1D flame simulation to account for 2D probe effects during sampling from the flame.

## Apparatus:

3 separate experimental facilities for flame temperature measurements and mobility sizing.

Stanford Facilities: custom burner-stabilized flame 5 cm burner

Measurements:

1. Temperature measurements

Fast-insertion method with radiation correction. The uncertainty is 10-90 K depending on the measured temperature. For further details, see Camacho 2015.

2. Evolution of mobility PSDF, number density and volume fraction

Mobility sizing was carried out on an TSI SMPS (models listed above for each facility). Sampling procedures have been standardized as to minimize artifacts due to probe sampling. For further details, see Camacho 2015.

## 2. Particle mass vs. particle mobility size

Mass measurement by CPMA was carried out in tandem with measurement of the mobility PSDF such that the mobility size distribution was measured for a given monodisperse (by mass) aerosol flow.

Summary of Conditions

laminar, atmospheric pressure premixed BSS flames

16.3% (mol) ethylene and 23.7% (mol) oxygen in argon. The unburned gas has an equivalence ratio, , of 2.07 and a cold velocity of 8 cm/s (298 K and 1 atm).