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Impact of hydrogen as a fuel additive on the formation of soot precursors and particles in atmospheric laminar premixed flames of methane

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1. Context

- Hydrogen as a fuel additive
 - ☺ Non carbonaceous species
 - ☺ High LHV (120MJ/kg)
 - ⊗ High flammability limit
 - ⊗ High flame speed
 - GN (Natural Gas)
 - Large reserve
 - Main compound: CH₄
 - Low CO₂ emission
- H₂ + NG → Credible Transition Solution**
- Automotive engines
 - Gas turbines
 - Industrial and domestic burners

2. Objective

- ✓ Co-combustion properties of H₂ and CH₄ on emission of :
 - Soot particles
 - Soot precursors
 - CO, CO₂

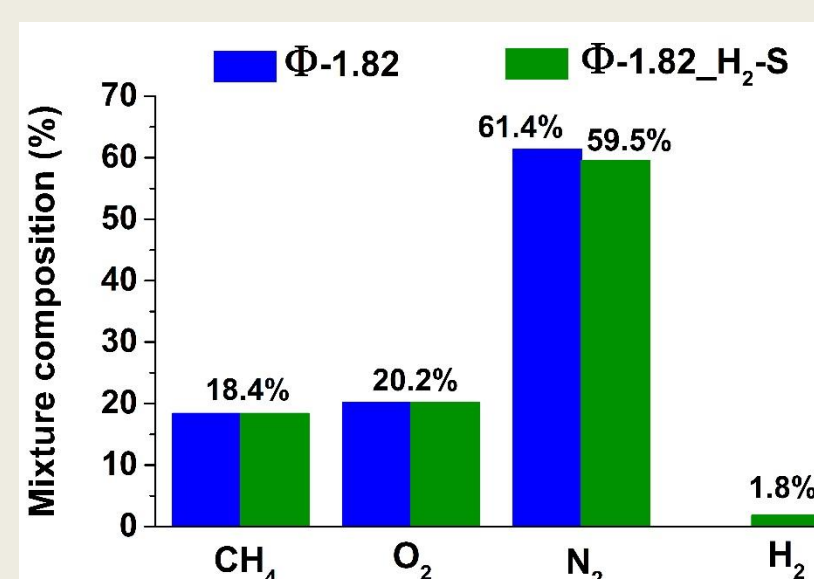
3. Flame condition

Slight sooting premixed flame

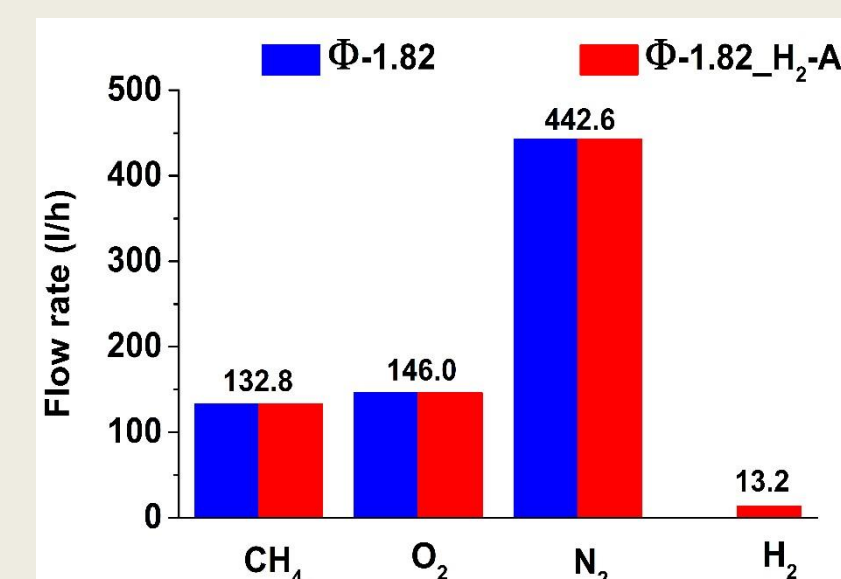


H₂ + CH₄/O₂/N₂

H₂ Substitution

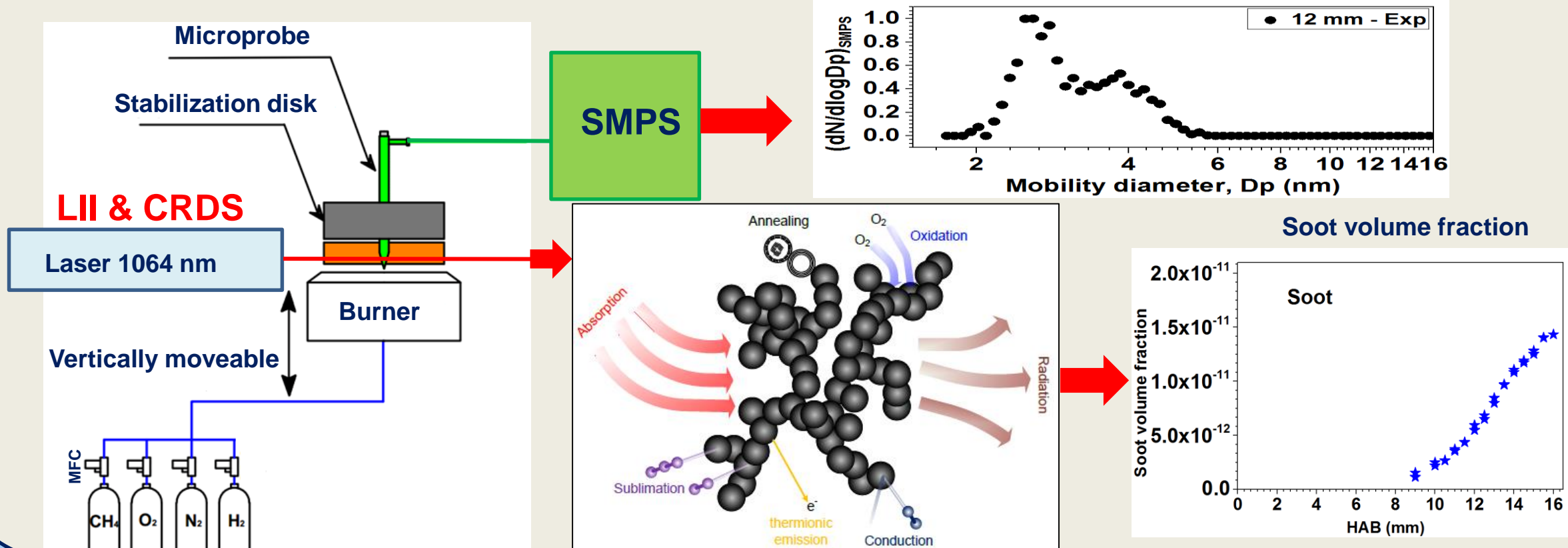


H₂ Addition

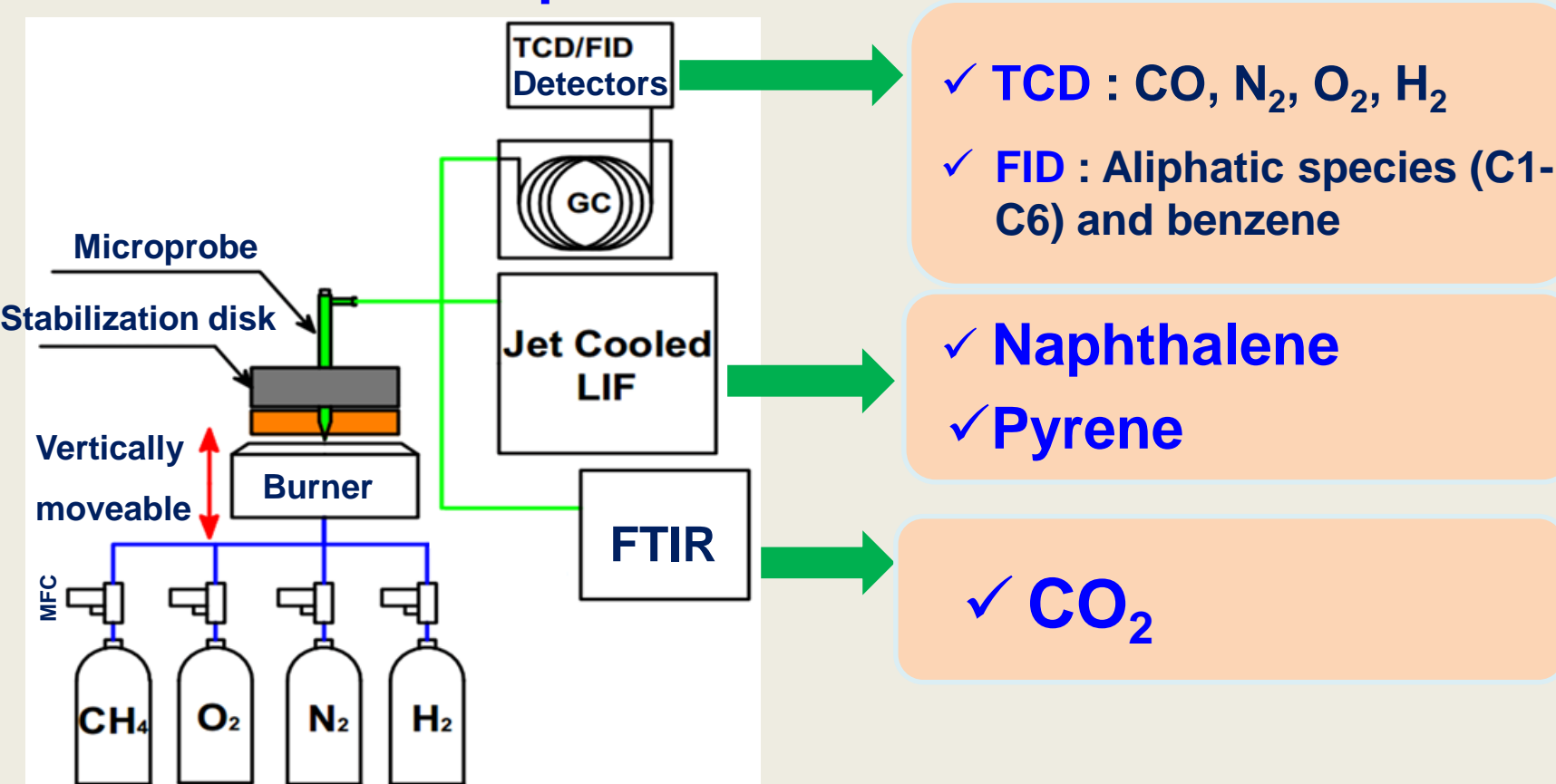


4. Experimental section

Soot measurements

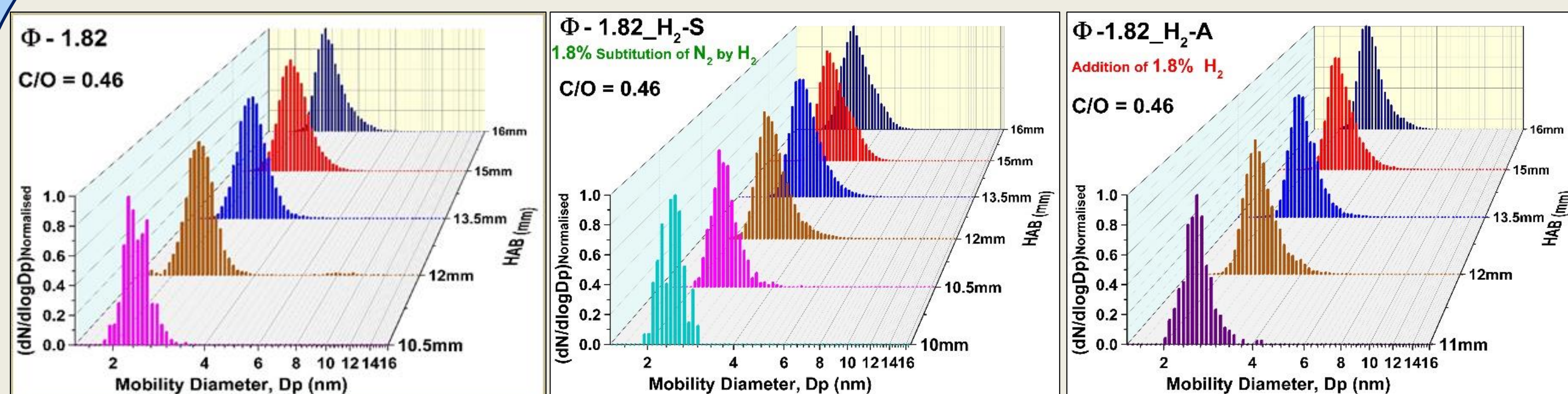


Gaseous species measurements



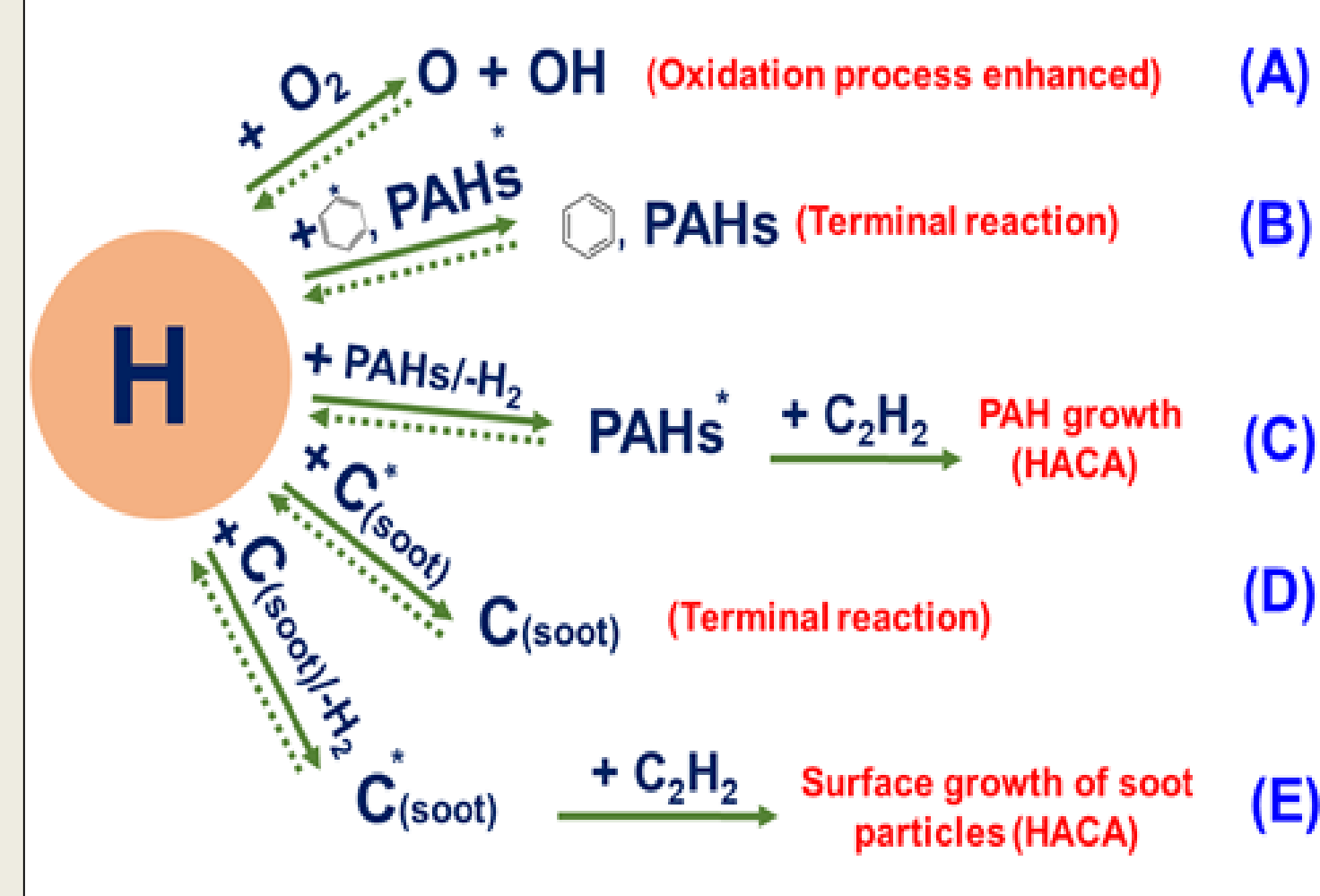
5. Results

Soot particle sizer distribution function (PSDF)

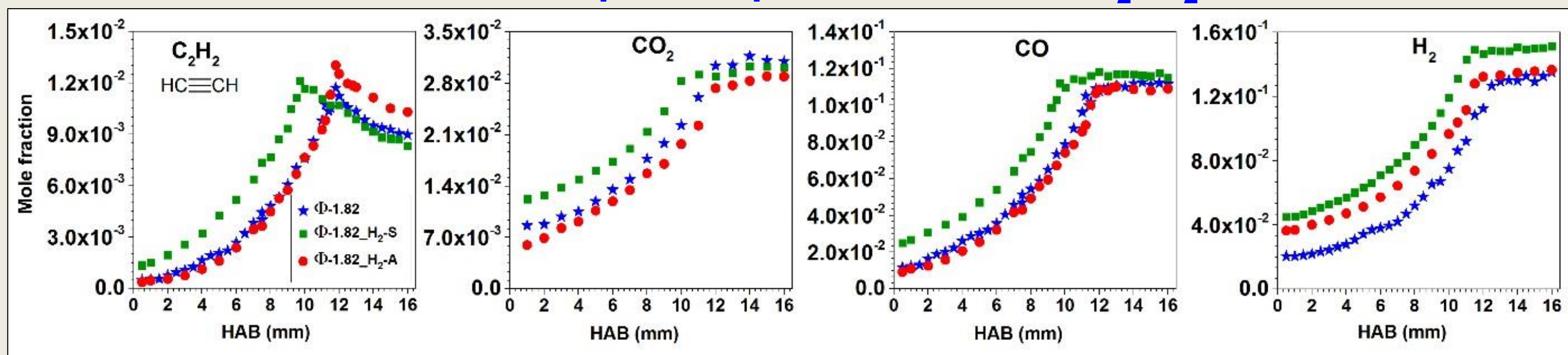


Small impact on PSDF

Kinetic impact of hydrogen atom on soot formation process

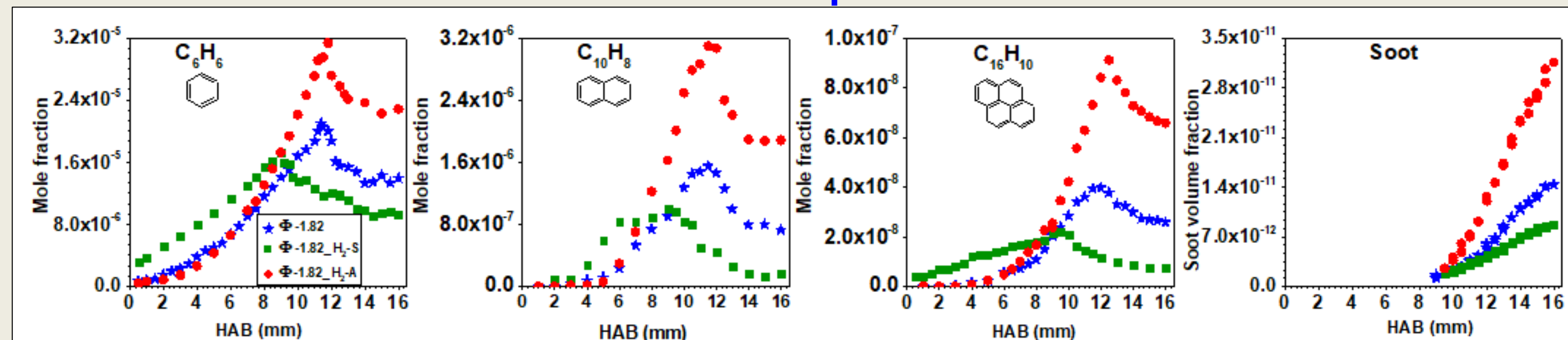


Aliphatic species and CO, CO₂, H₂



Small impact on formation of aliphatic species and CO, CO₂, H₂

Aromatic species and soot



Change of soot volume fractions profiles essentially depending on aromatic species concentrations

Aromatic species and soot formation strongly impacted by H₂ introduction

6. Conclusion

- The H₂ introduction into slight sooting premixed flames of methane strongly influences the formation of soot and their precursors
- This impact depends on the operating conditions (addition or substitution)