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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: CH<sub>4</sub>
  - Low CO<sub>2</sub> emission



H<sub>2</sub> + NG

Credible Transition Solution

- Automotive engines
- Gas turbines
- Industrial and domestic burners

## 2. Objective

- ✓ Co-combustion properties of H<sub>2</sub> and CH<sub>4</sub> on emission of :
  - Soot particles
  - Soot precursors
  - CO, CO<sub>2</sub>

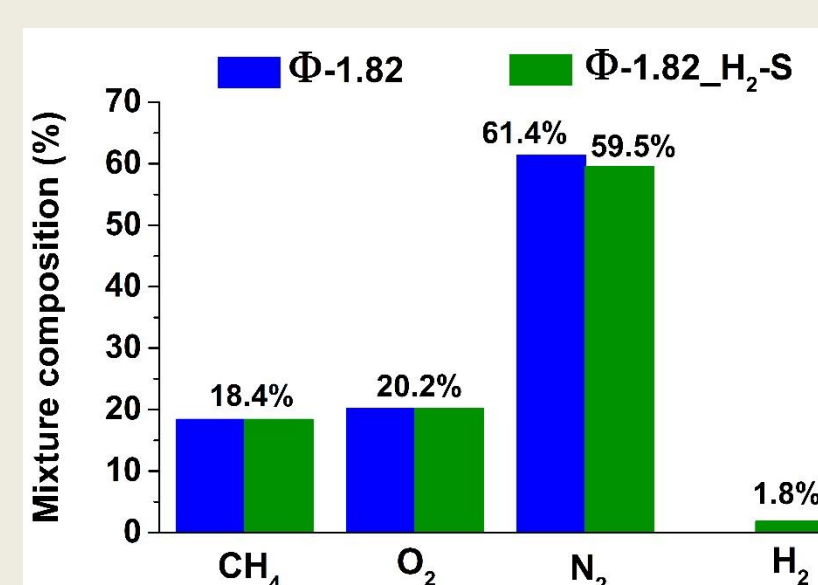
## 3. Flame condition

Slight sooting premixed flame

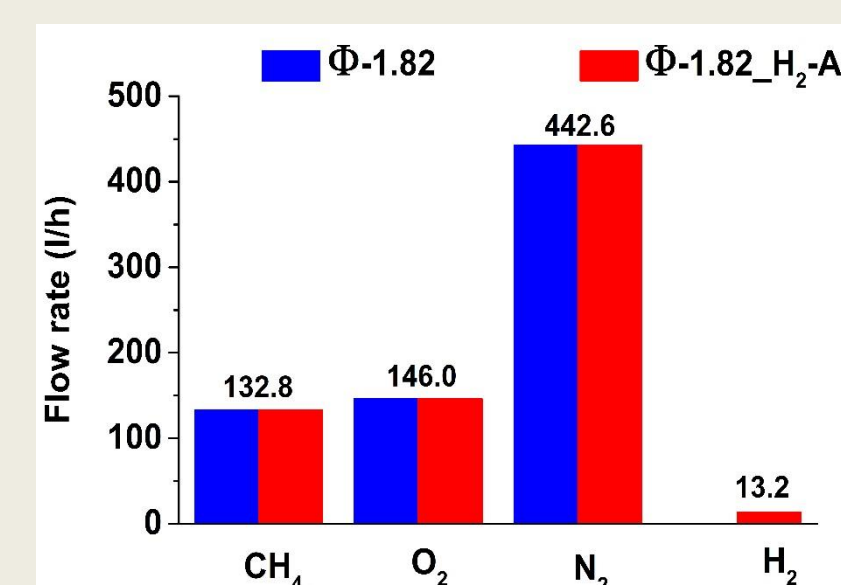


H<sub>2</sub> + CH<sub>4</sub>/O<sub>2</sub>/N<sub>2</sub>

### H<sub>2</sub> Substitution

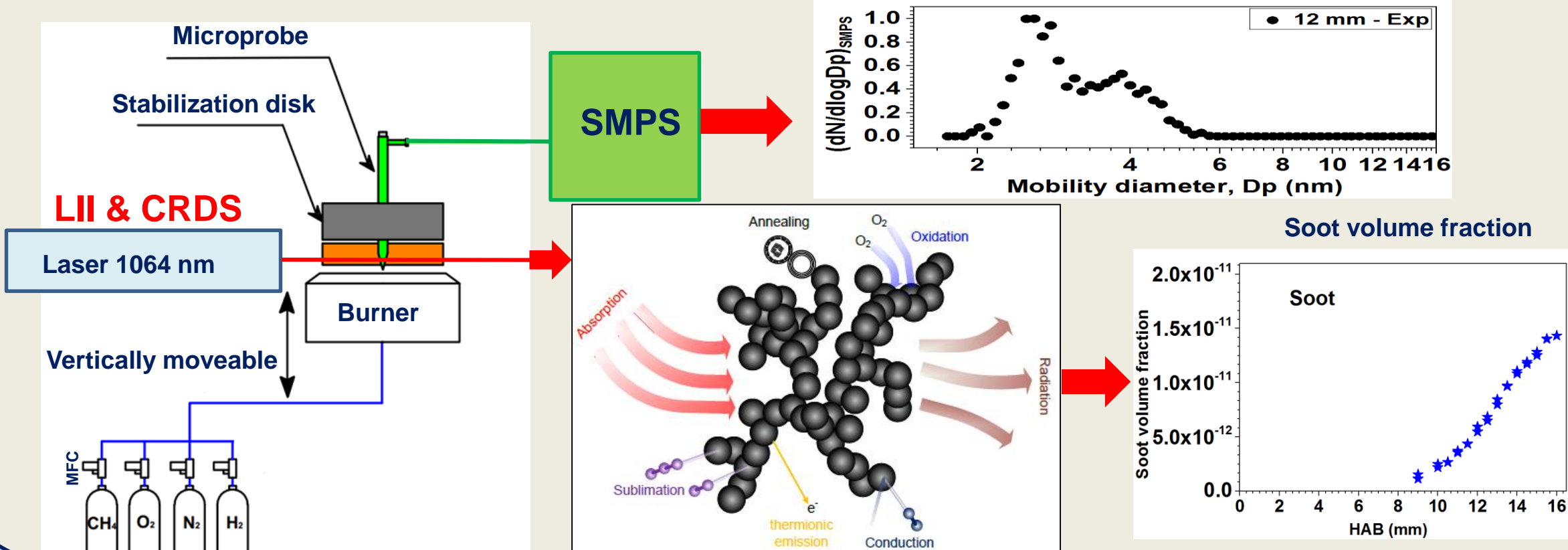


### H<sub>2</sub> Addition

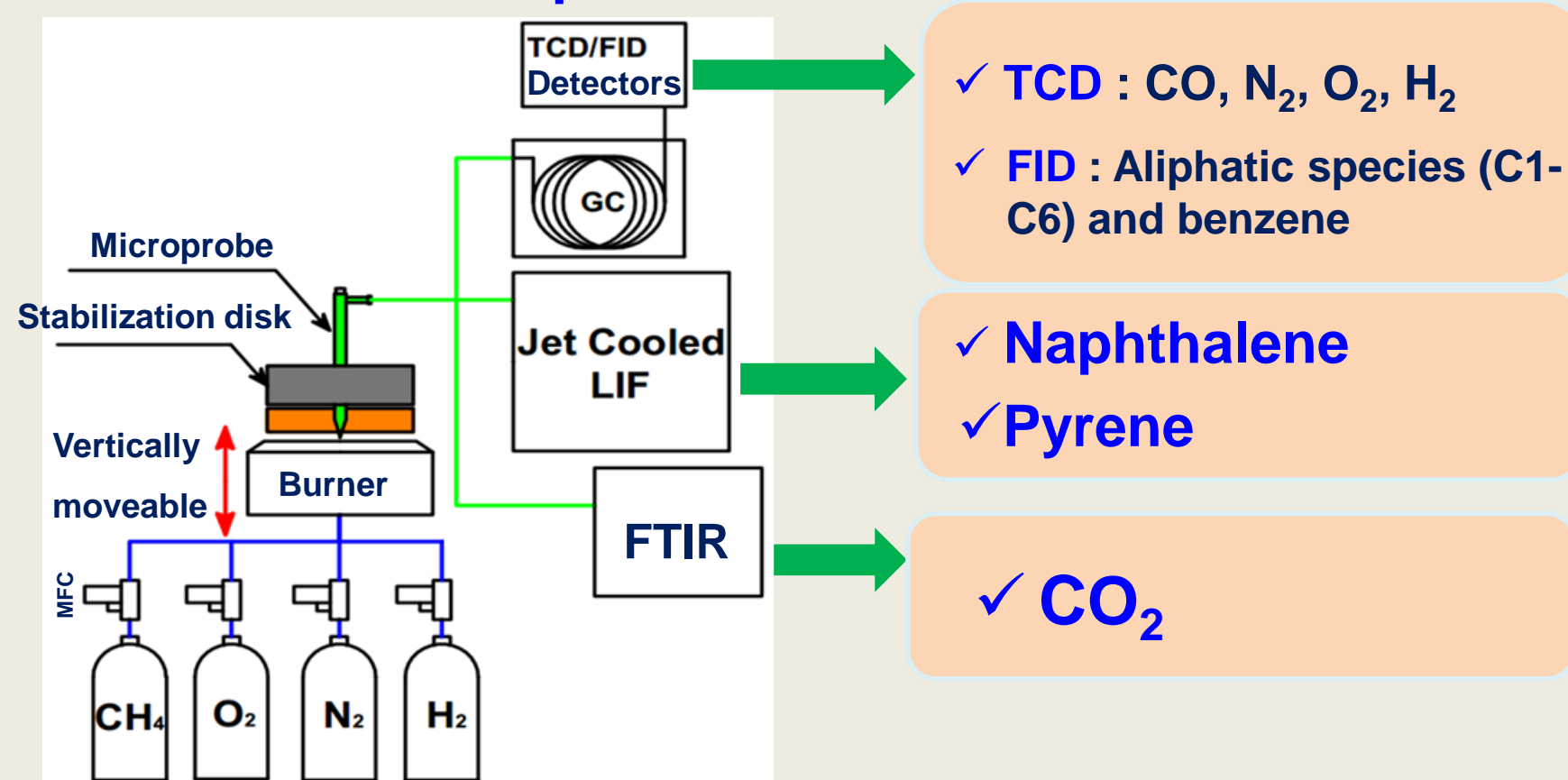


## 4. Experimental section

### Soot measurements

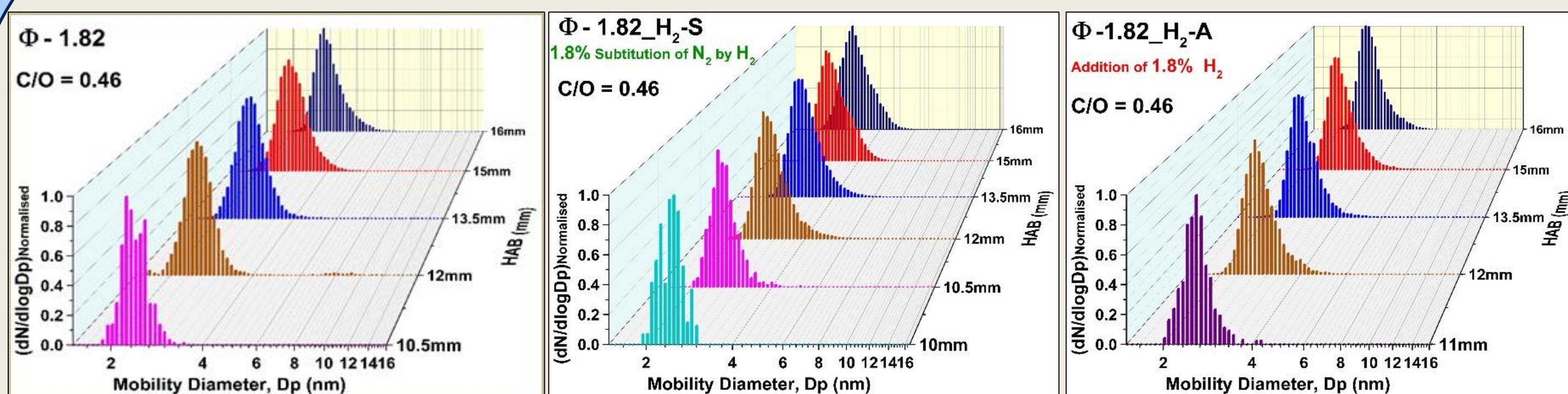


### Gaseous species measurements



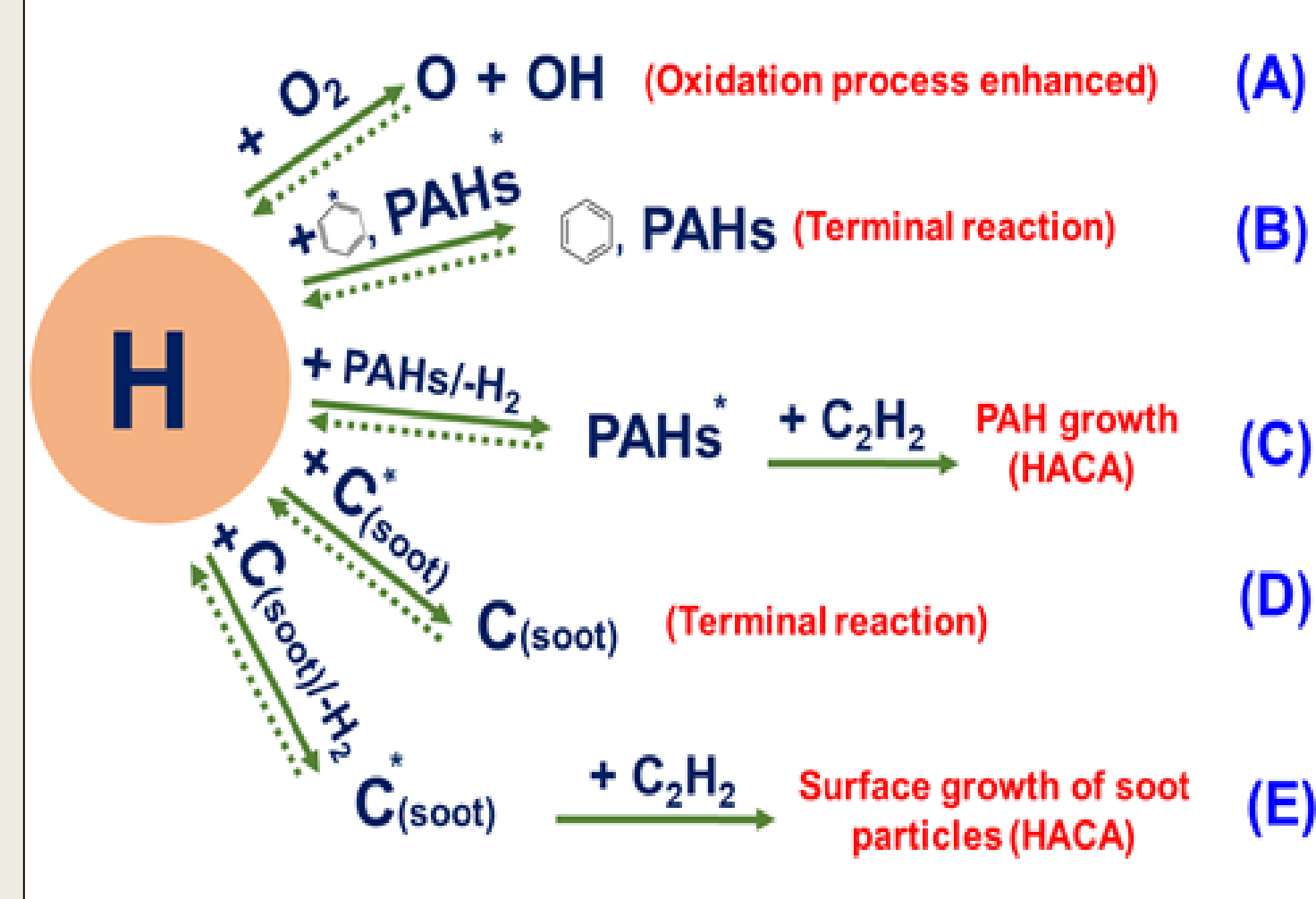
## 5. Results

### Soot particle sizer distribution function (PSDF)

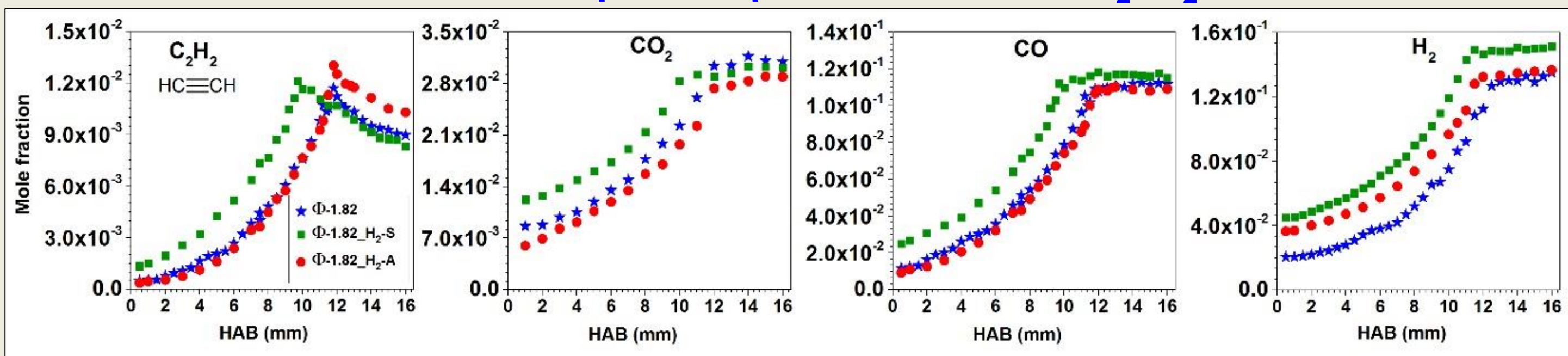


Small impact on PSDF

### Kinetic impact of hydrogen atom on soot formation process

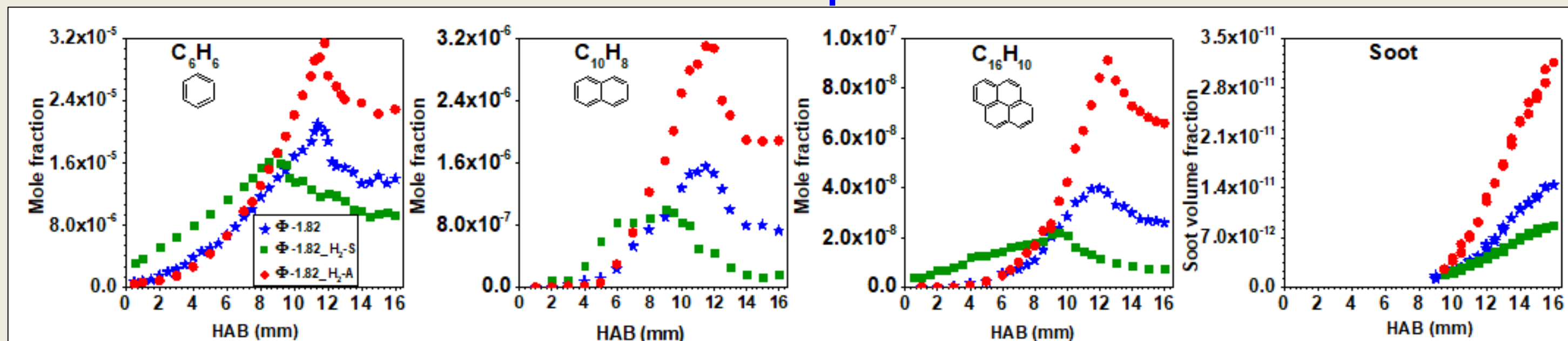


### Aliphatic species and CO, CO<sub>2</sub>, H<sub>2</sub>



Small impact on formation of aliphatic species and CO, CO<sub>2</sub>, H<sub>2</sub>

### Aromatic species and soot



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

Aromatic species and soot formation strongly impacted by H<sub>2</sub> introduction

## 6. Conclusion

- The H<sub>2</sub> 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)