



In-situ laser spectroscopy and modeling of bituminous coal in a laboratory-scale FBC

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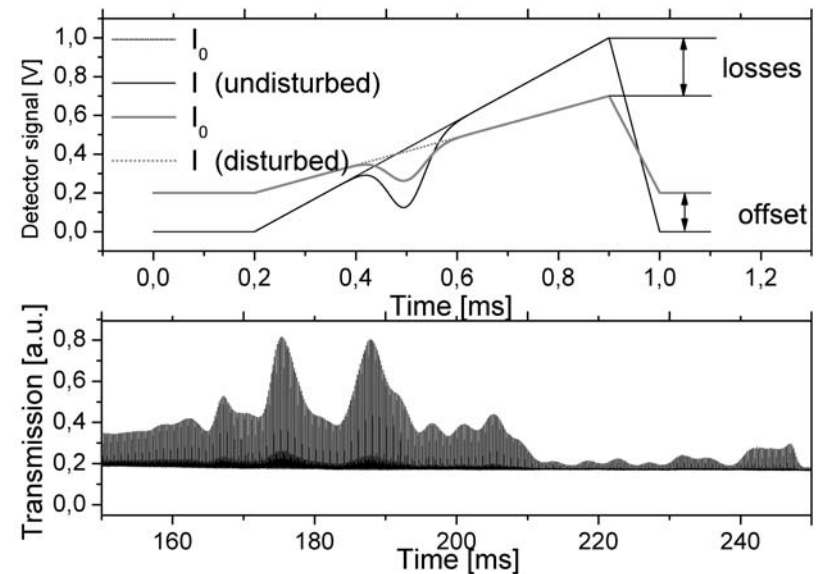
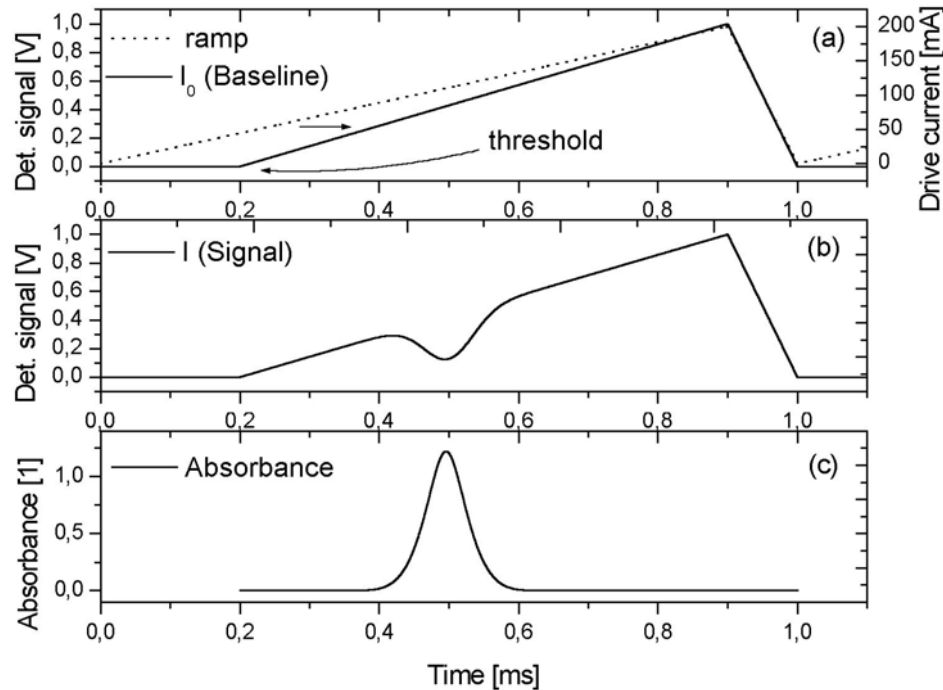
45th IEA-FBC Meeting, Prague, November 18th, 2002



Outline

- *In-situ* tunable diode laser spectroscopy
- Experimental setup
- Modeling
- Results and Discussion
- Summary

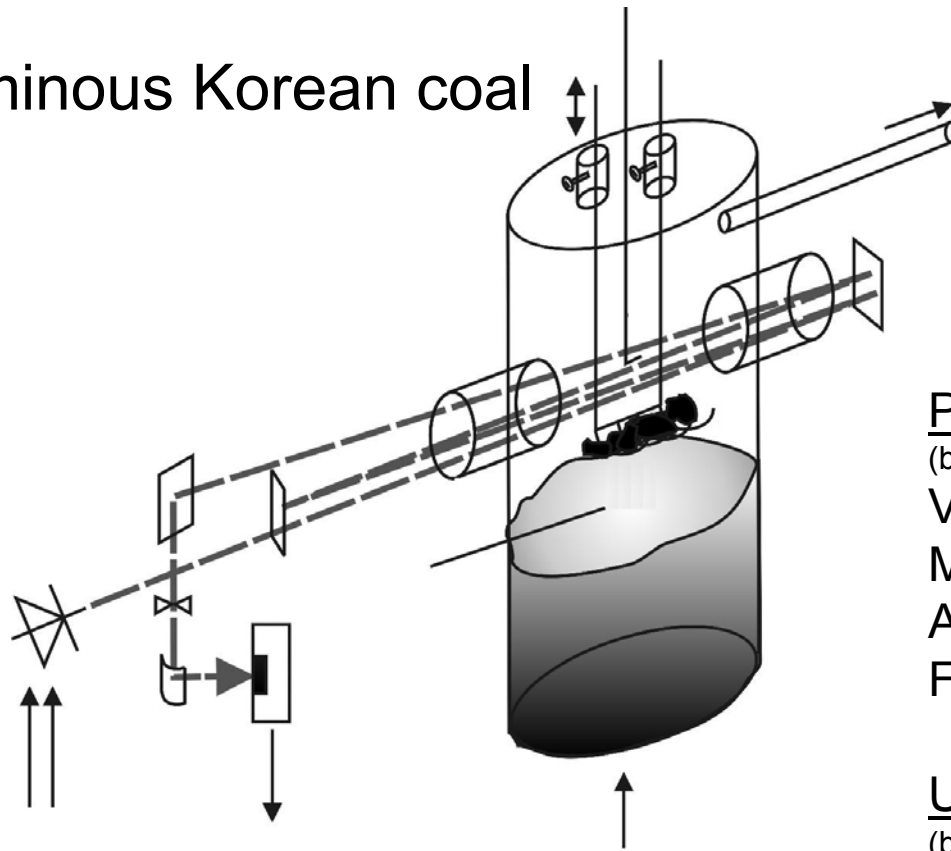
(1) *In-situ* tunable diode laser spectroscopy



In this study: 2.3 μm laser for CO and CH₄

(2) Experimental setup

Bituminous Korean coal



In-situ:

CO, CH₄
Temperature

Ex-situ:

CO, CO₂, O₂

Proximate analysis

(by weight)

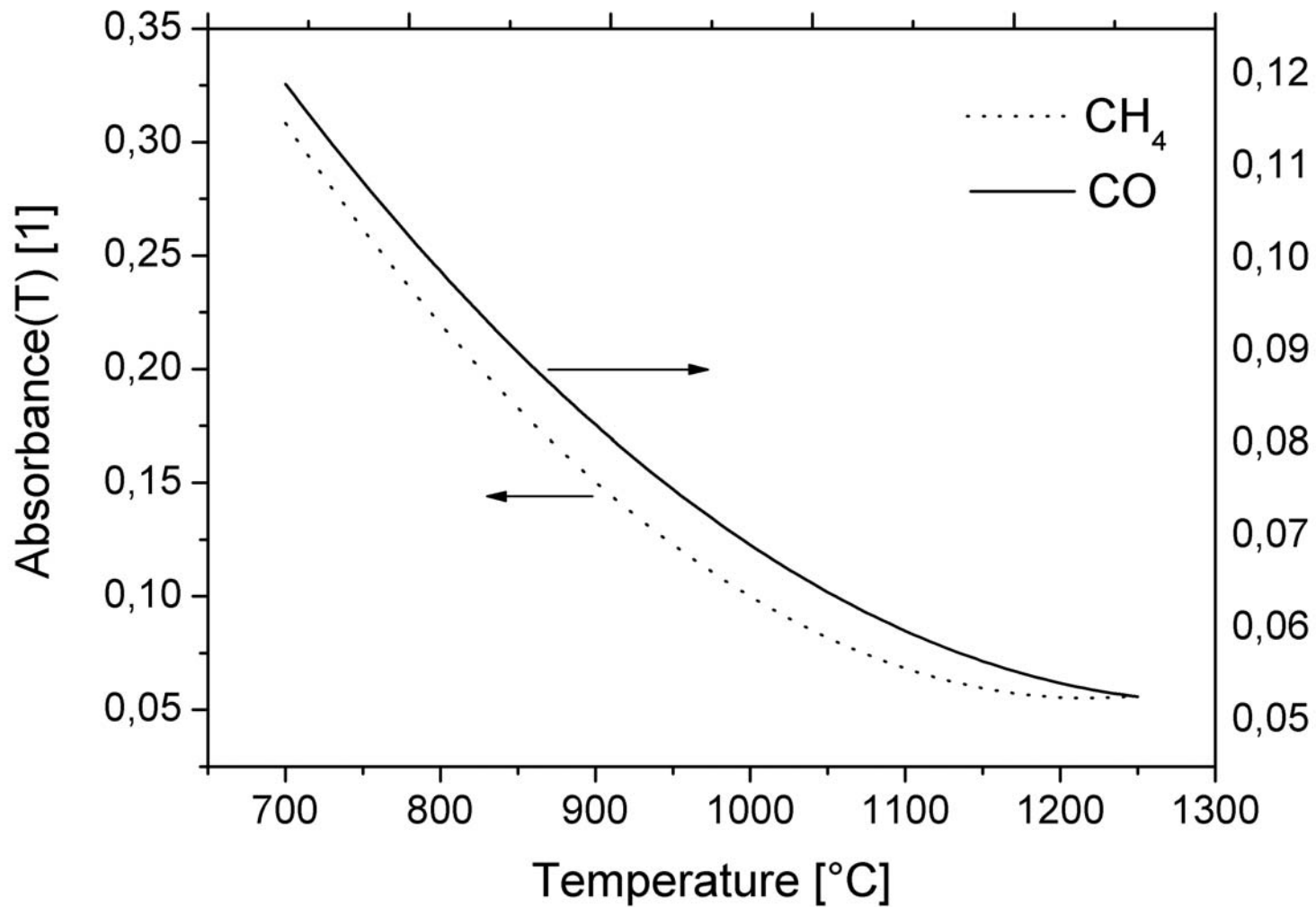
Volatile matter	30.6
Moisture	1.6
Ash content	15.2
Fixed carbon	52.6

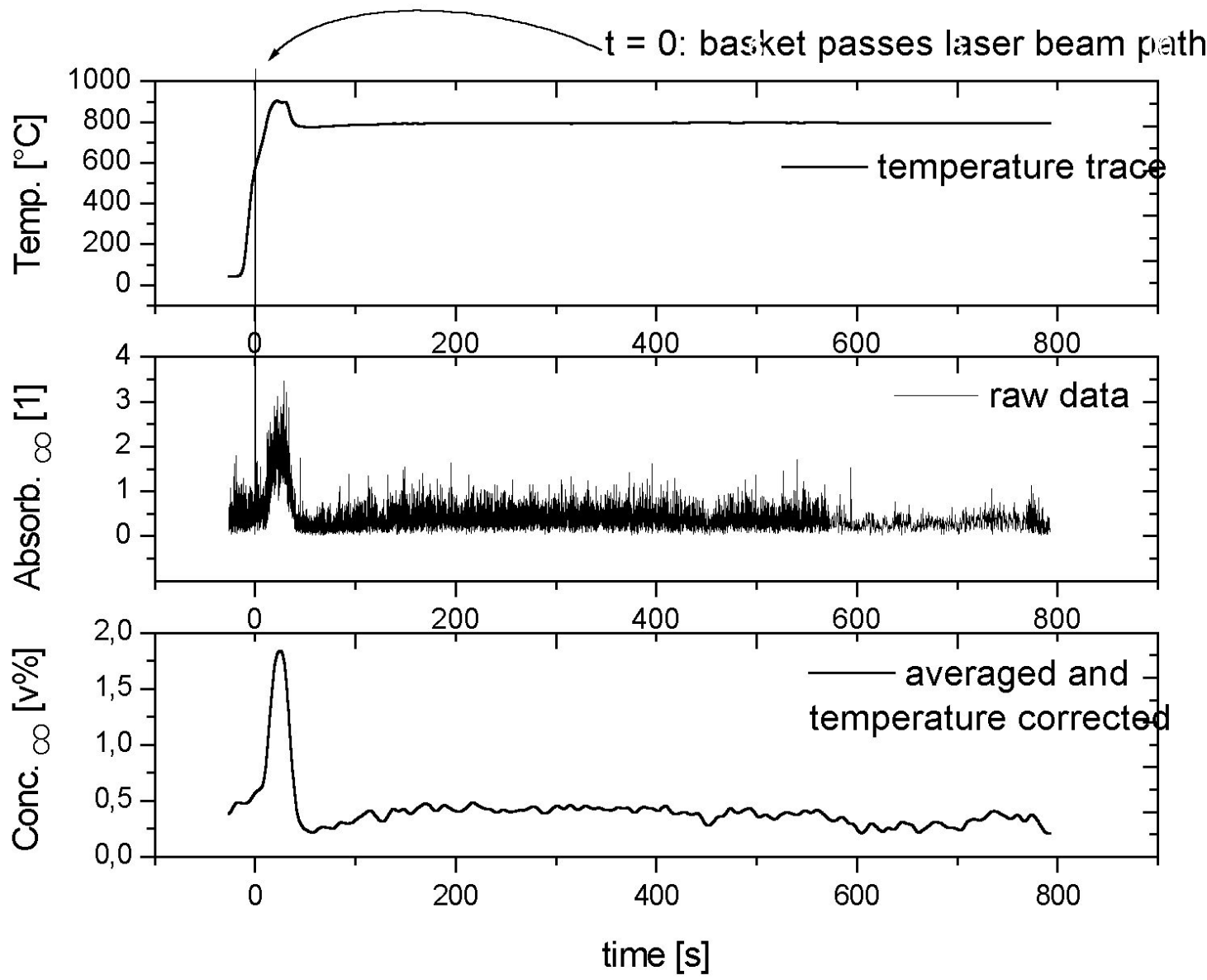
Ultimate analysis

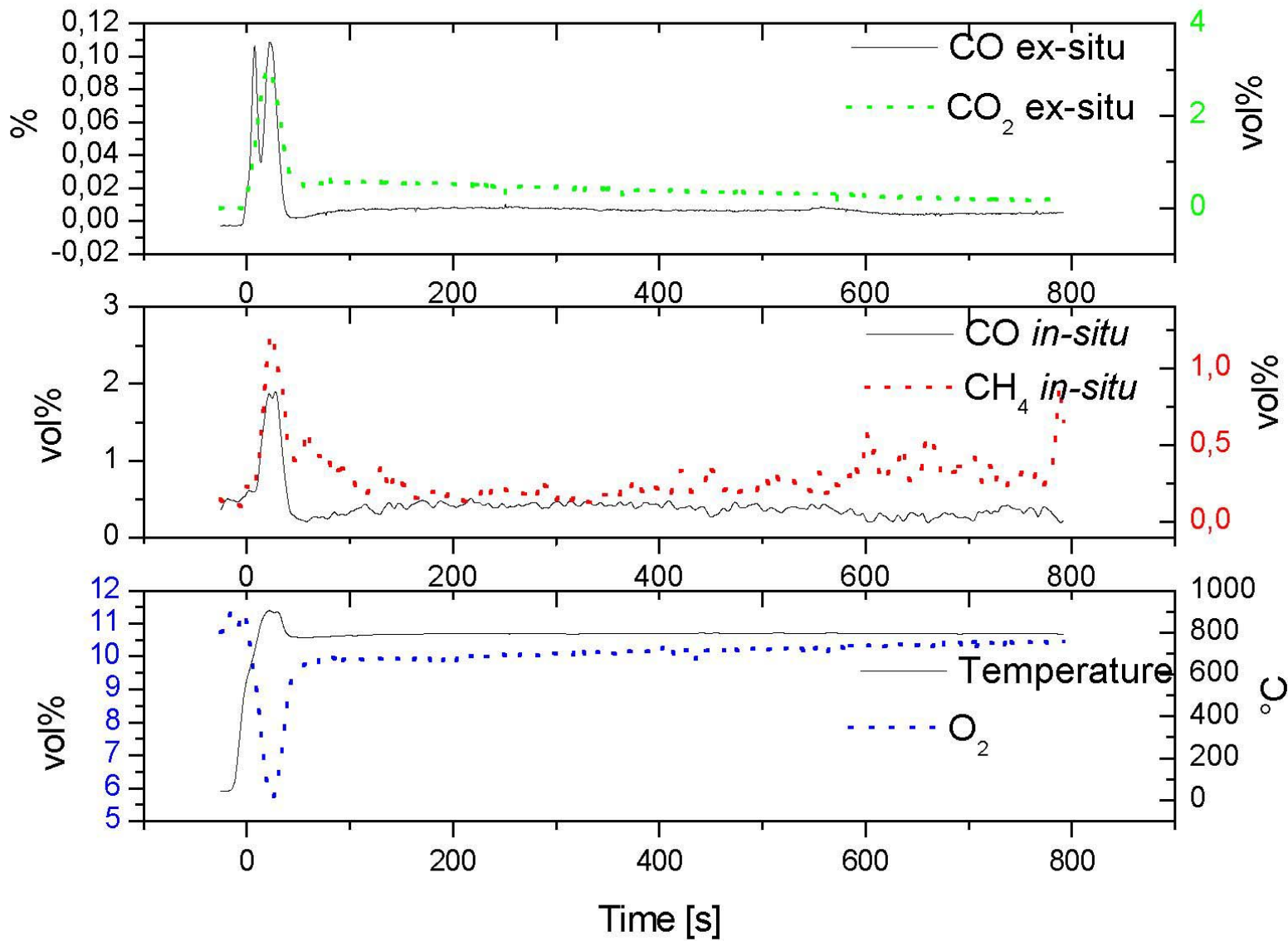
(by weight, water and ash free)

Carbon	66.0
Hydrogen	4.1
Nitrogen	1.3
Oxygen (by diff.)	28.6

Temperature:	700-900 °C
O ₂ :	5-20 % (vol.)
Distance:	4-31 mm (10 mm ~30ms)







(3) Modeling

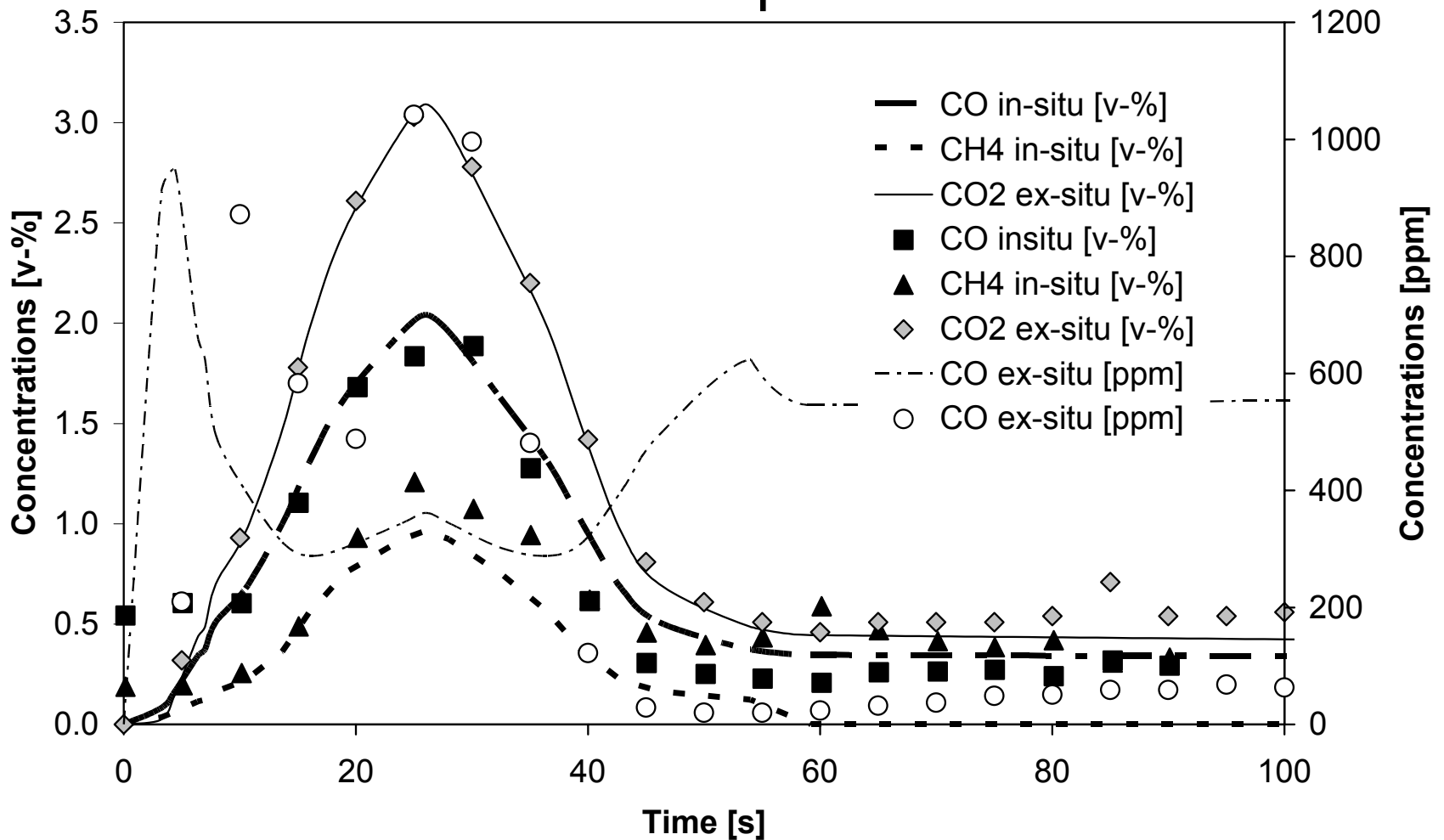
Modified devolatilization model developed by van der Bleek [1]:

- | | |
|---------------------------------------|---|
| •all volatile | N → NH ₃ or HCN (HCN/NH ₃ =3) |
| •75 % of volatile | H → CH ₄ |
| •if C limiting reactant, all volatile | C → CH ₄ |
| •all remaining volatile | C → CO |
| •if O limiting reactant | O → CO |
| •all remaining volatile | O → H ₂ O |
| •all remaining volatile | C → C ₂ H ₄ |
| •all remaining volatile | H, → H ₂ |
| •if H limiting reactant, all volatile | H → H ₂ O |
| •all remaining volatile | O → O ₂ |
| •No tar | |

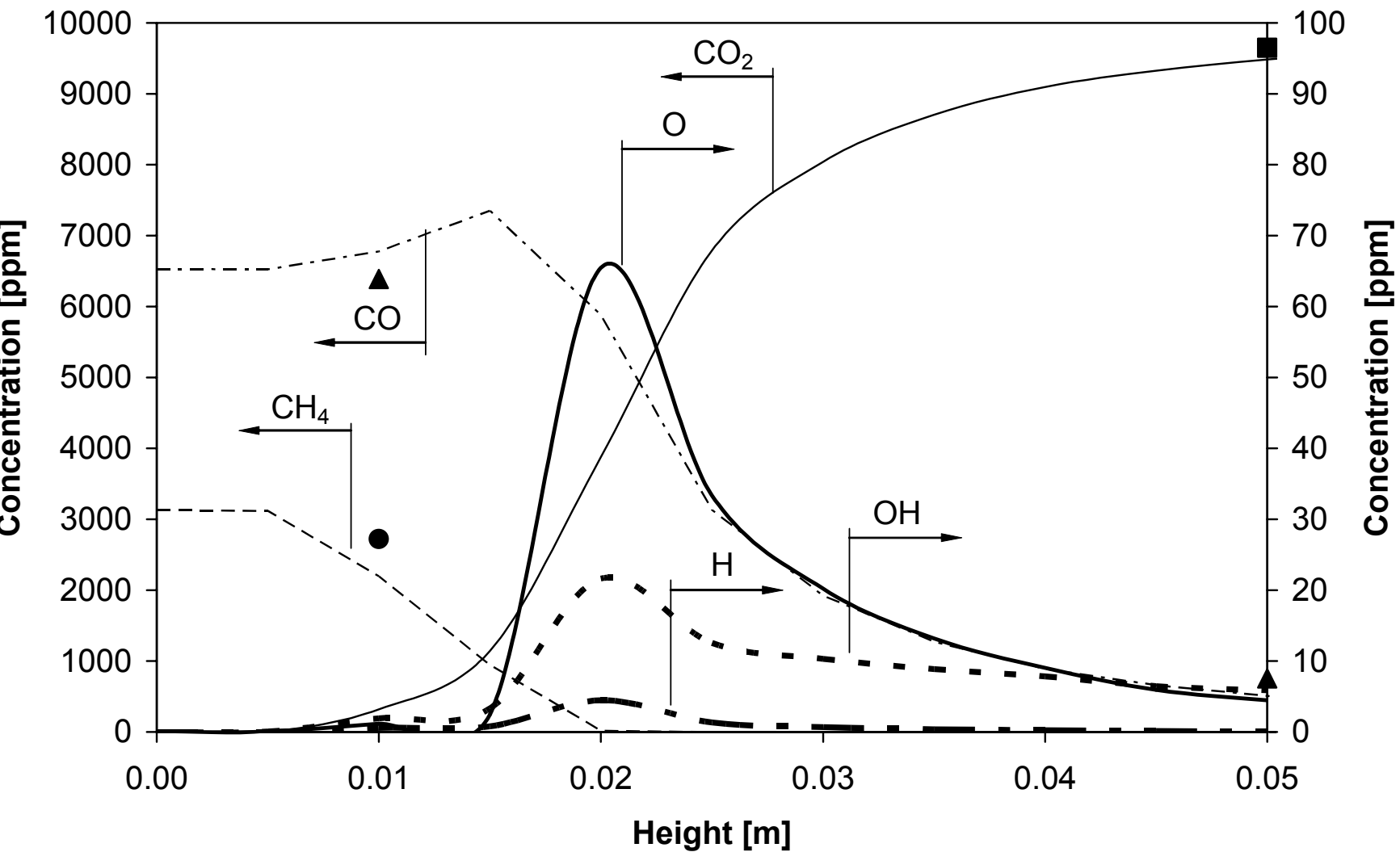
[1] van den Bleek, C.M.; Brem, G.; Grubor, B.; Johnsson, J.E.; Jones, R.F.; Langer, V.; Verwey, N., 1990, Documentation of the IEA-AFBC model, Version 1.1", G. Brem, (Ed.), TNO Apeldoorn, The Netherlands.

(4) Results and Discussion

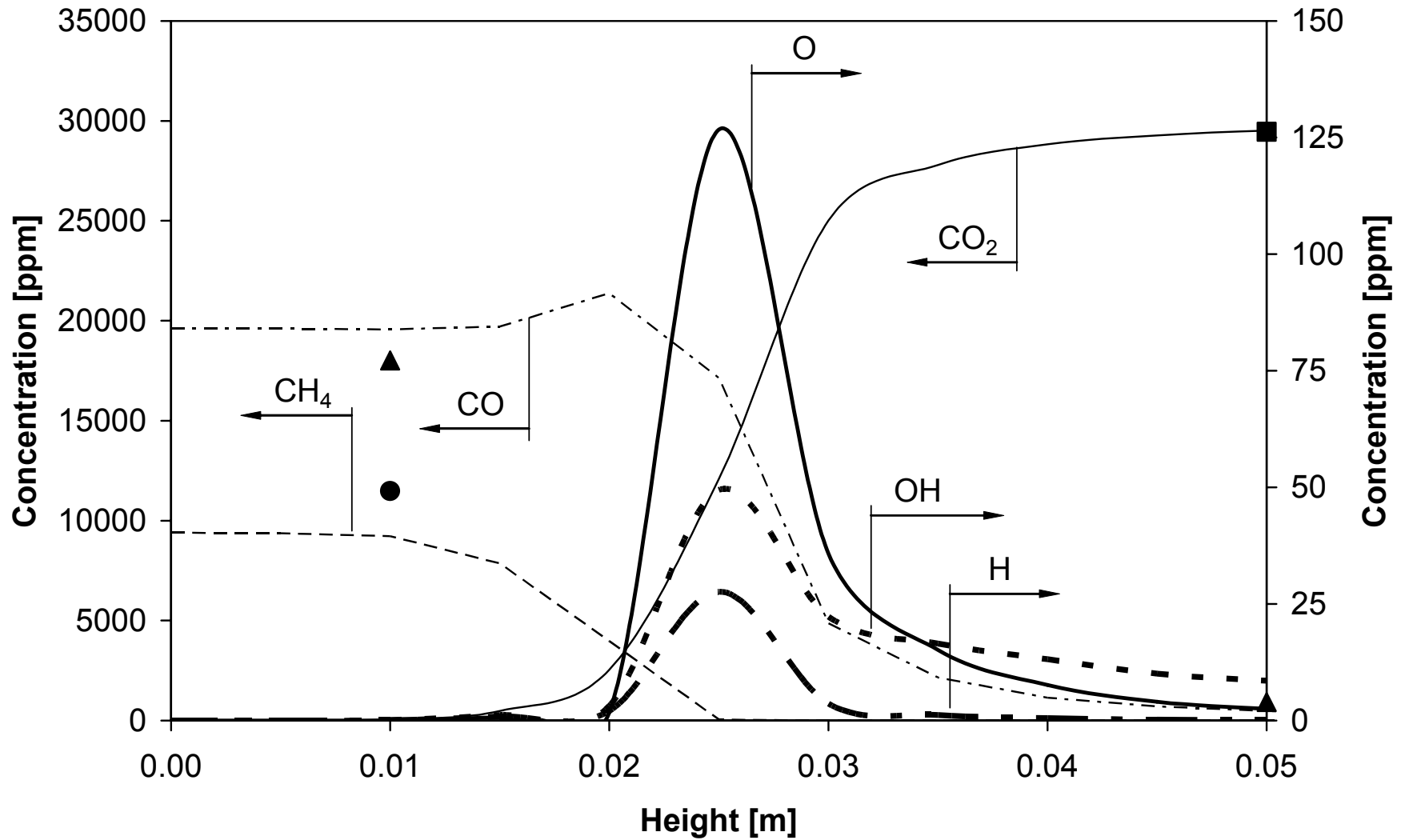
10 mm above particle



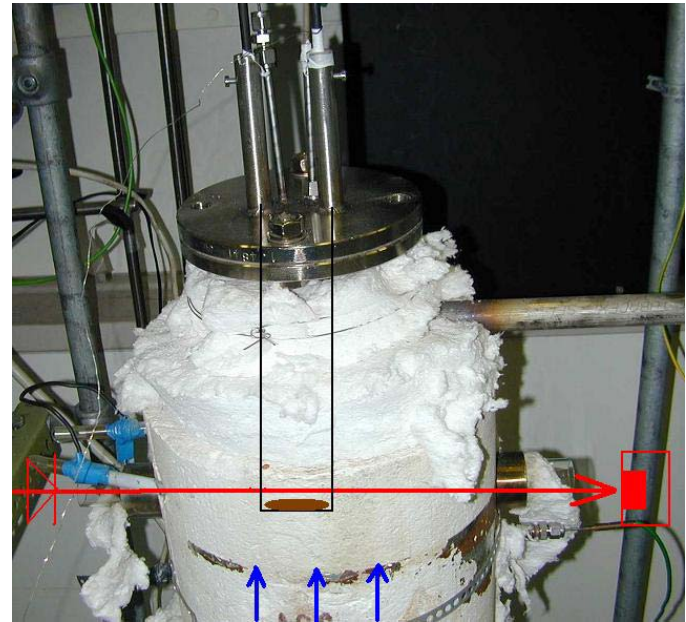
$t = 10$ s



$t = 24 \text{ s}$



Pictures I



(5) Summary

Investigation of carbon conversion of bituminous coal

- Marked differences between in-situ and ex-situ results
- Evidence for the release of slow volatiles

Outlook

- In-situ measurements of CO, CH₄ (2.3 μm) and H₂O (2.55 μm)
- Addition of radical quenchers (Br) for kinetic studies

Thank you for your attention!

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