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Proceedings

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Green aromatic bulk-chemicals from lignin pyrolysis vapours

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Green aromatic bulk-chemicals from lignin pyrolysis vapours

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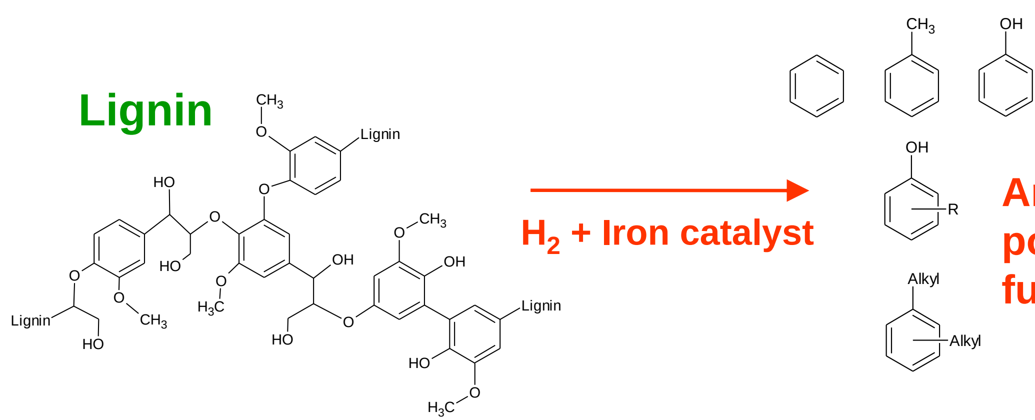
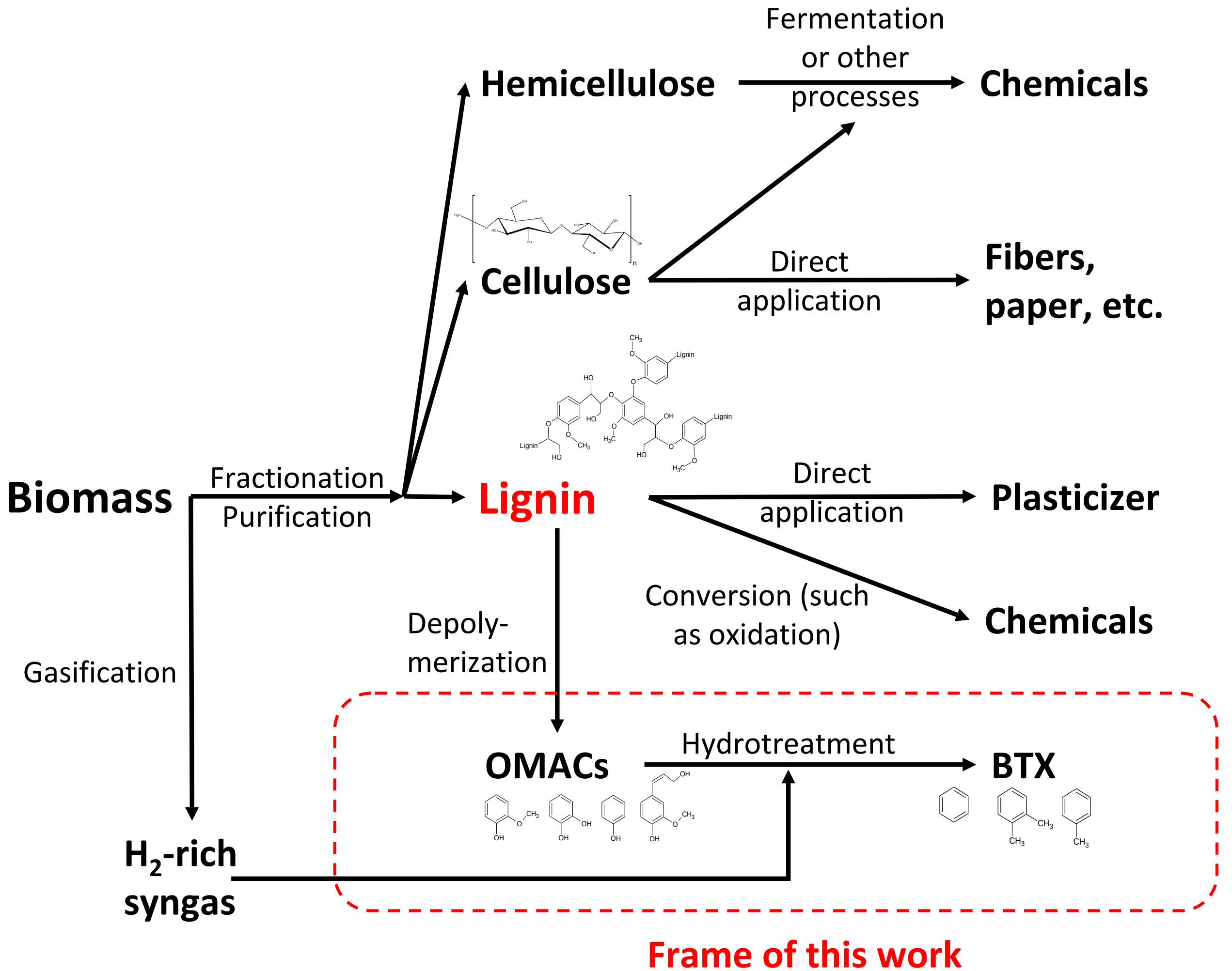
Lignin



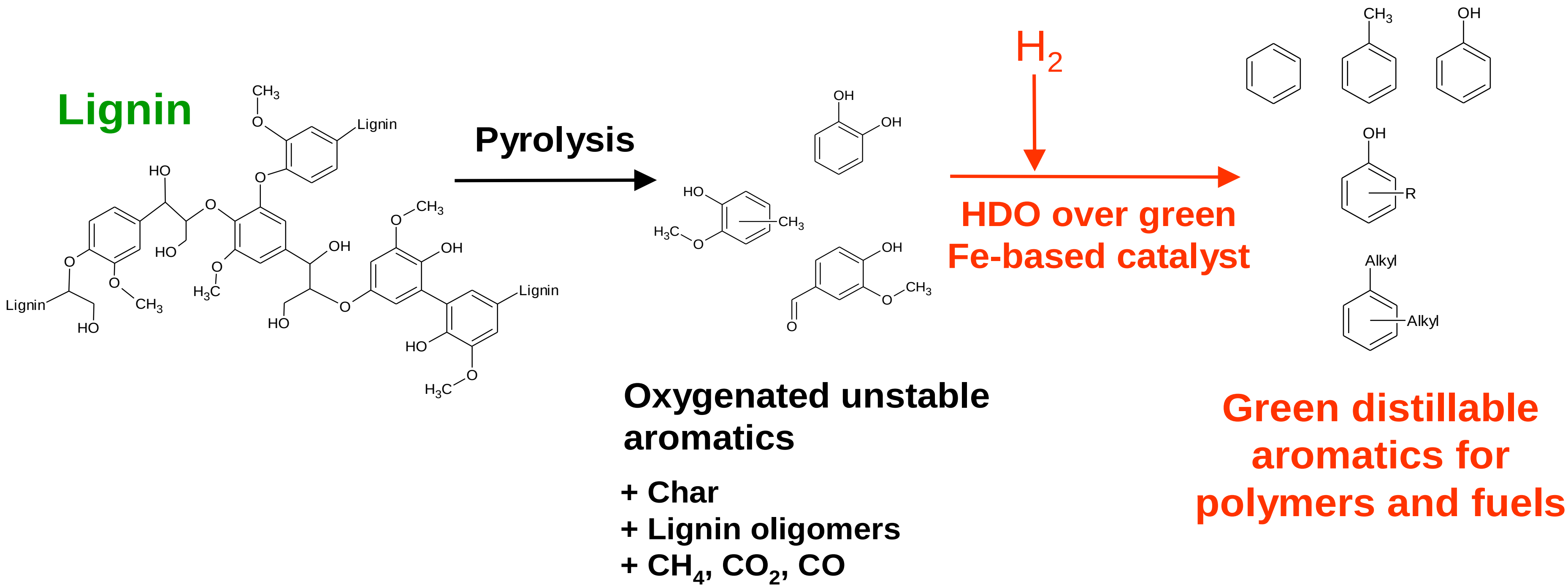
Aromatics for polymers and fuels

The production of aromatics from lignin is an important challenge for biorefinery

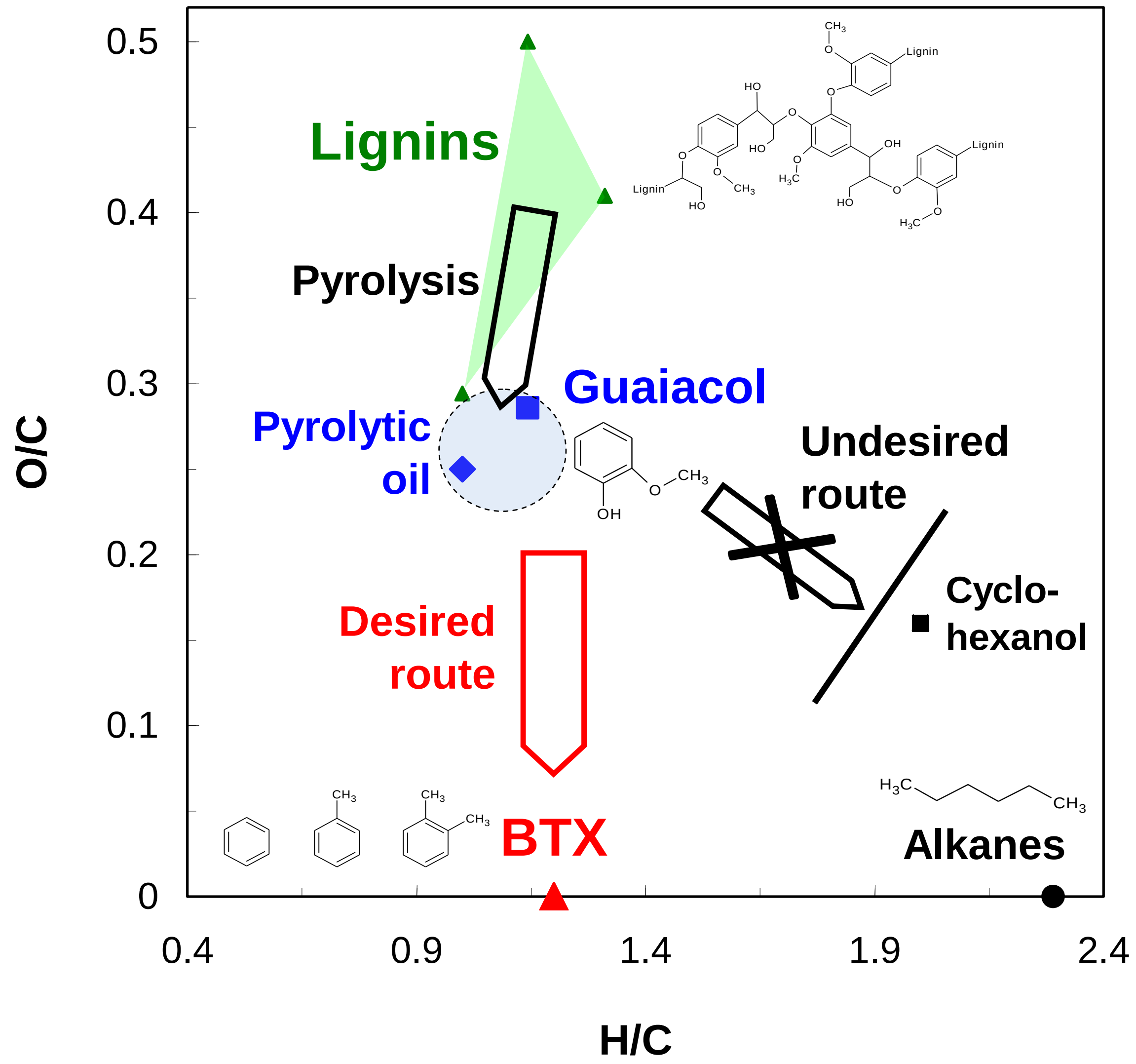


OMACs = Oxygenated Mono Aromatics Compounds

Aromatics could be produced by gas-phase hydrodeoxygenation (HDO) of pyrolysis vapours

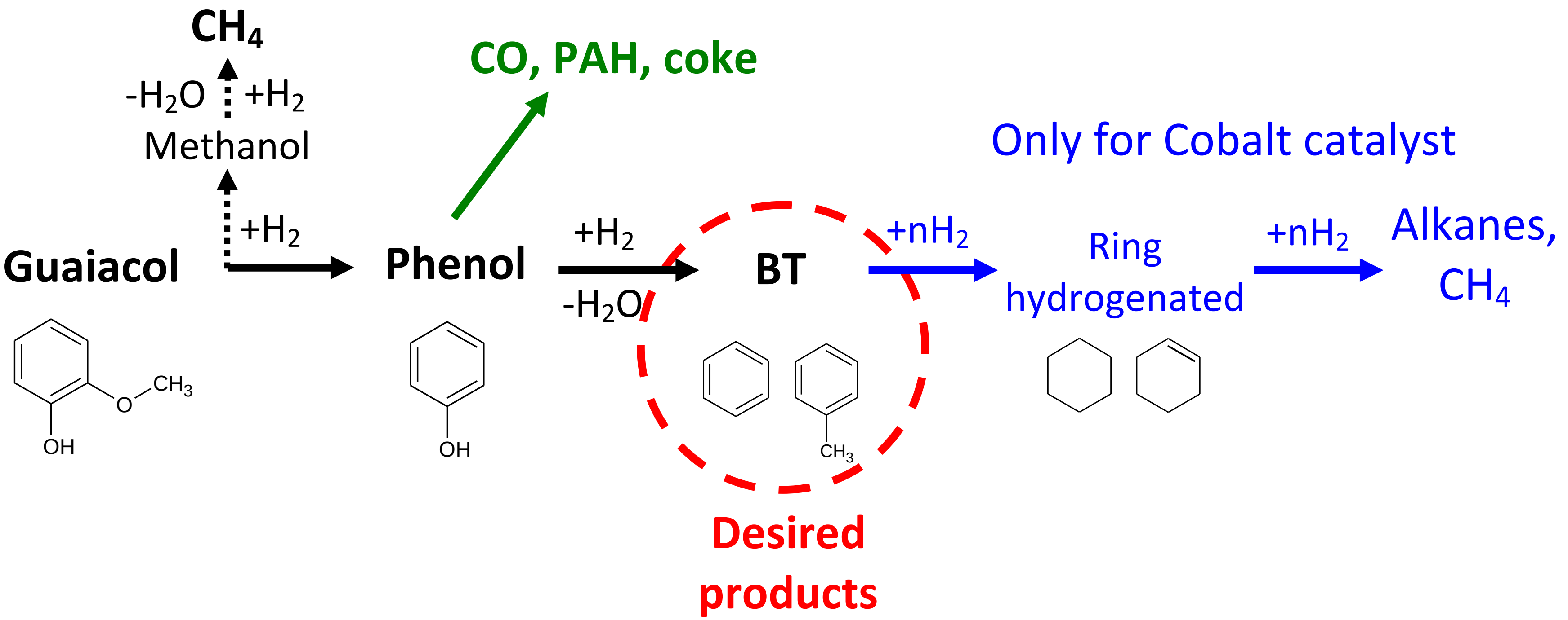


A green and cheap catalyst is looked for a selective HDO of oxygenated pyrolysis products



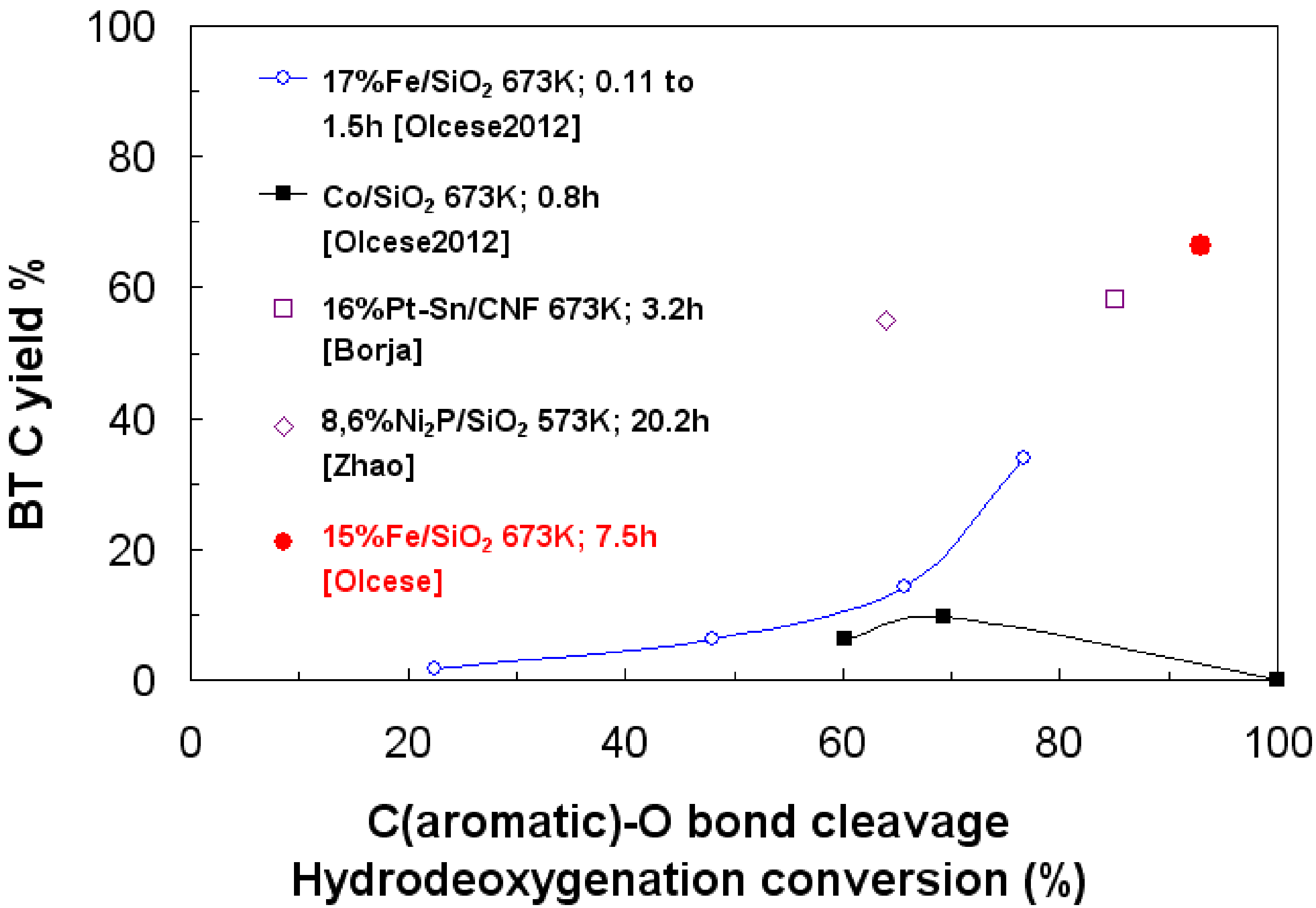
Olcese et al.
App. Catal. B.
115 (2012) 63

The HDO of guaiacol, a surrogate of pyrolysis products, has been studied over iron-based catalysts.



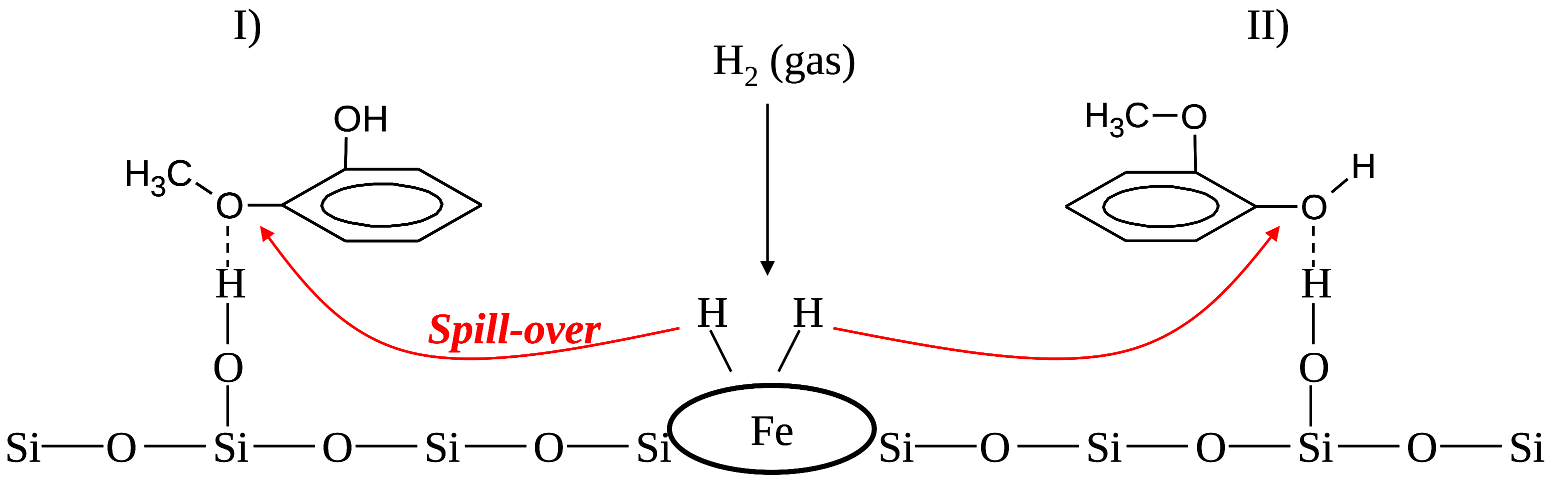
Olcese et al. App. Catal. B. 115 (2012) 63

Fe/SiO_2 is a selective catalyst for the HDO of guaiacol into benzene and toluene



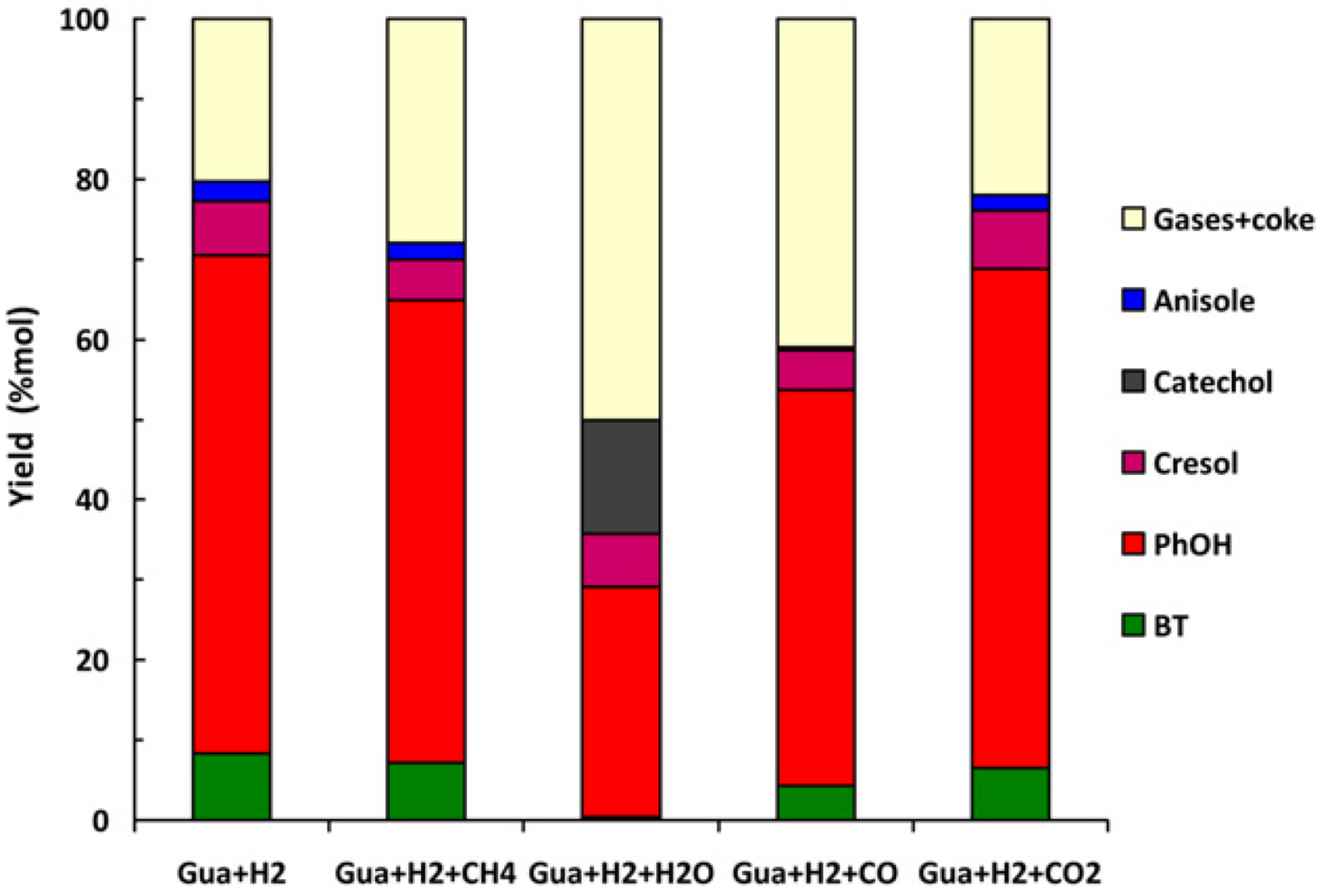
Mass residence time= 1/WHSV = g catalyst/(g guaiacol/h)

Catalytic mechanism of guaiacol HDO over Fe/SiO_2



Olcese et al. App. Catal. B. 116 (2012) 63-73

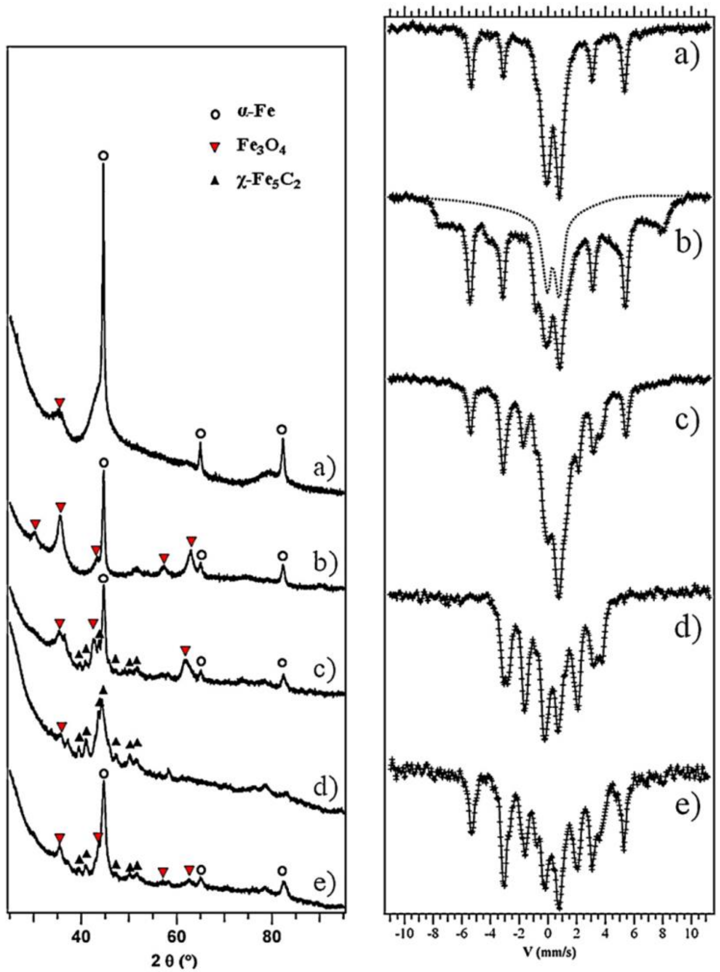
Gas composition has an effect on selectivity



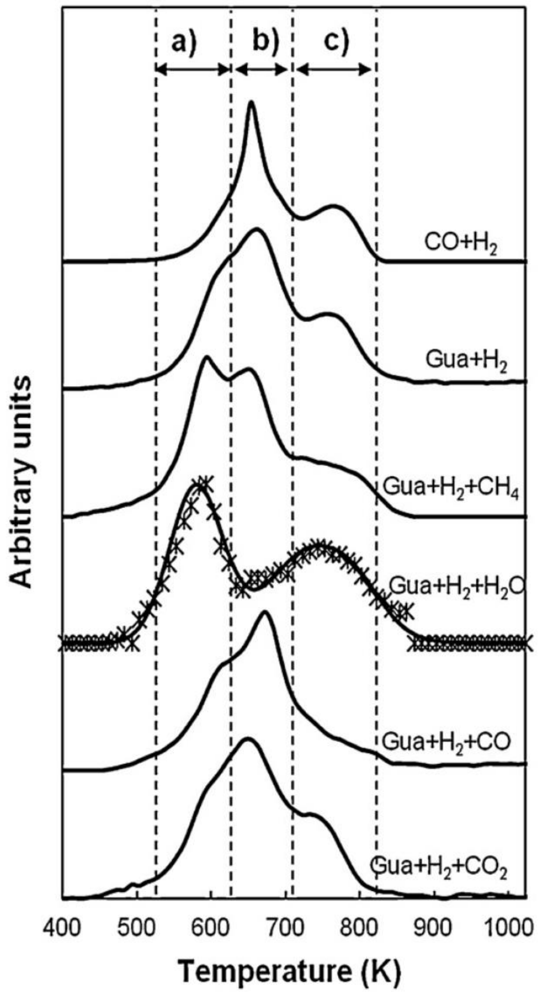
Olcese et al. App. Catal. B. 129 (2013) 528

Gas composition has an effect on iron speciation and on « coke » composition

Iron speciation analysed by XRD & Mössbauer

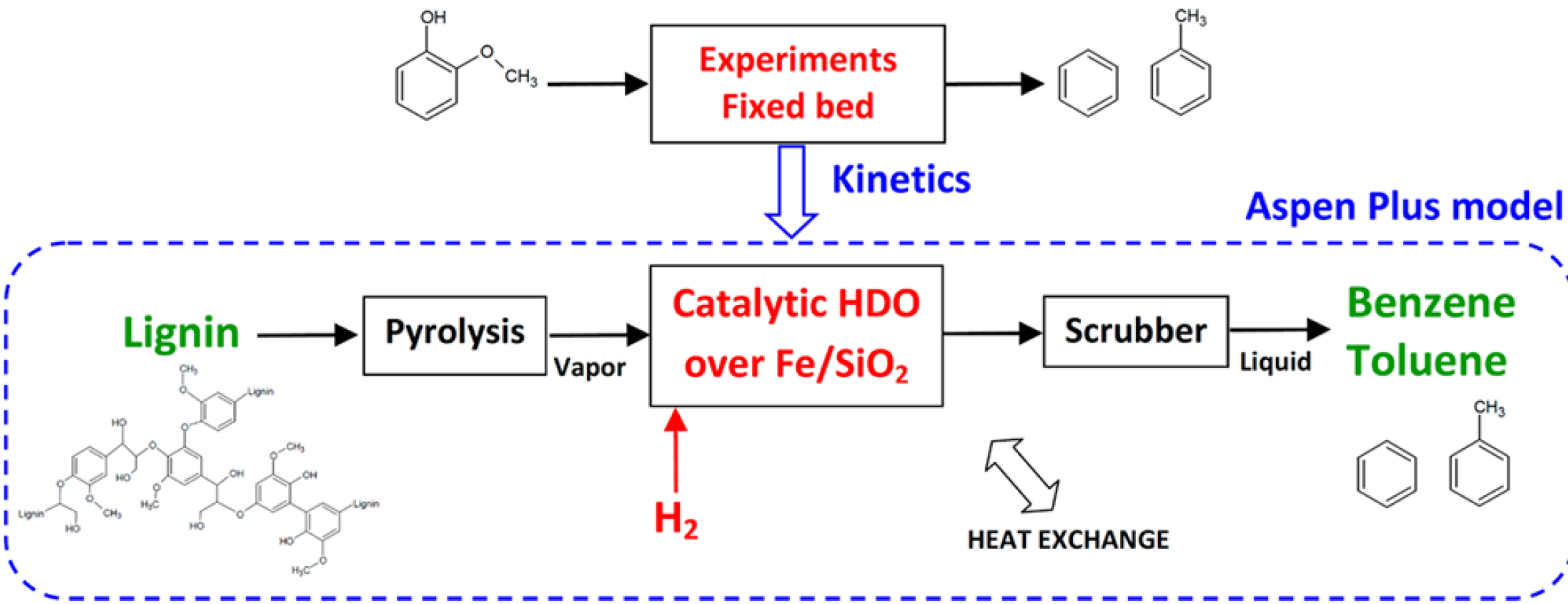


Coke analysed by Temperature Programmed Oxidation



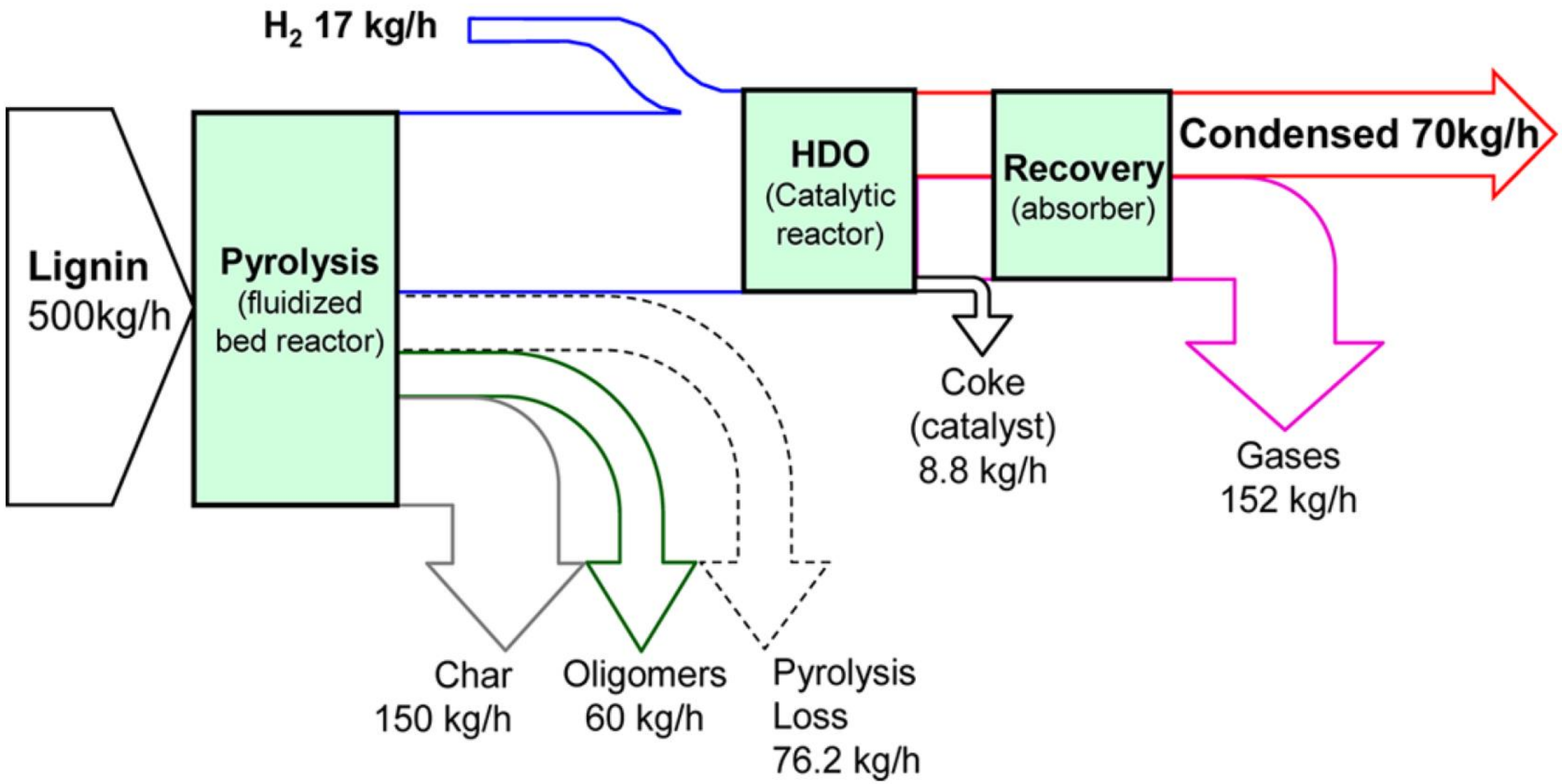
App. Catal. B. 129 (2013) 528

A kinetic model has been developped and included under Aspen Plus for process modeling



Olcese et al. Energy Fuels 27 (2013) 975

Mass balance of the whole lignin to BTX process is modeled



Char and oligomers represent a key issue to improve lignin conversion yields into aromatics

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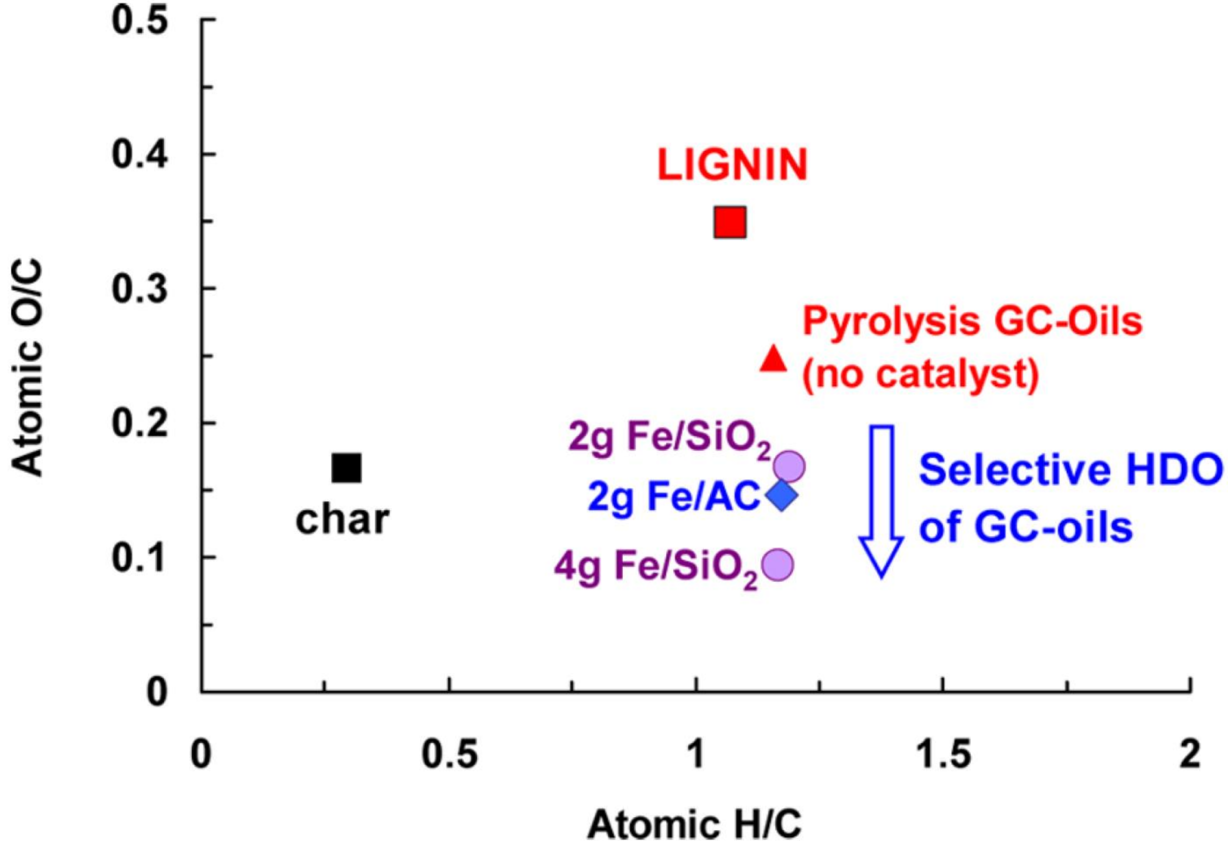
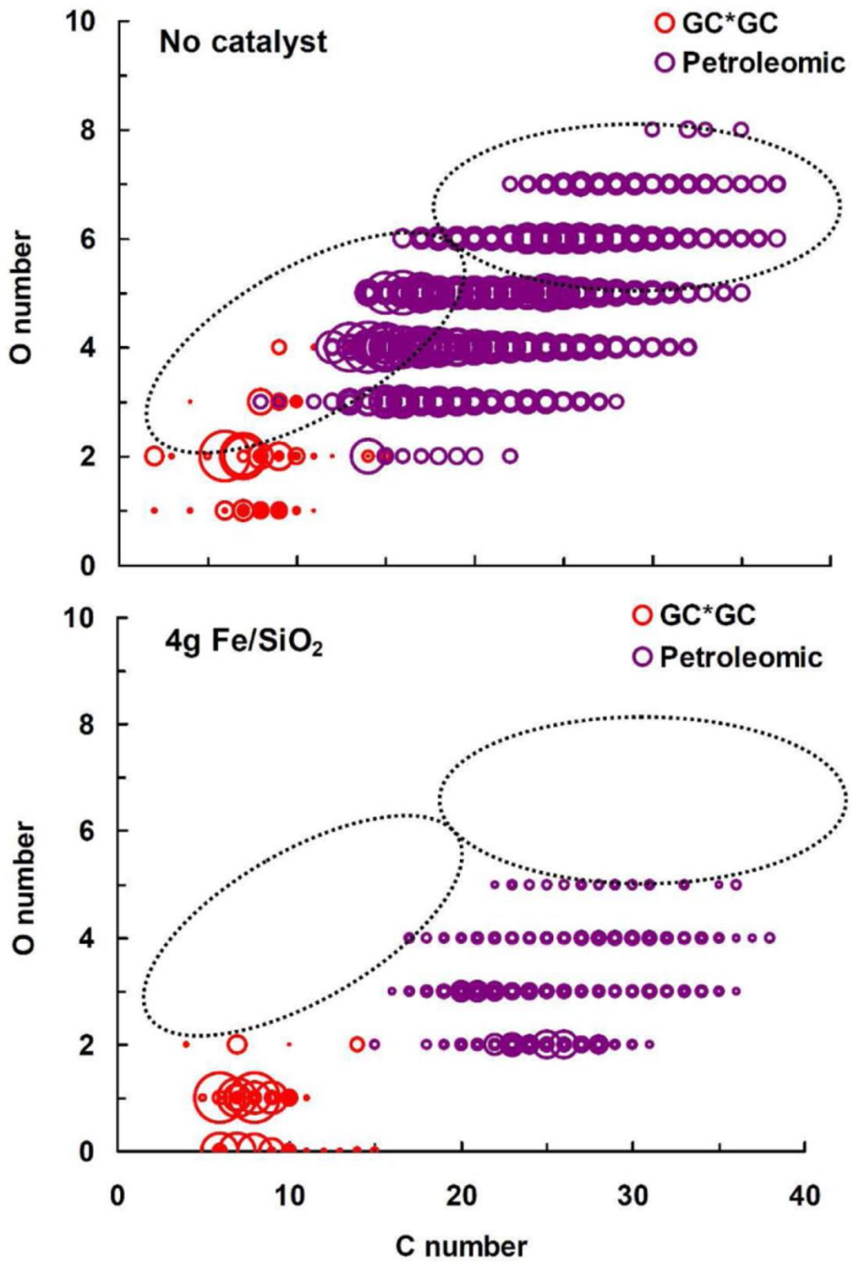
Experiments have also been conducted on REAL pyrolysis vapours



A selective HDO has been obtained by iron-based catalysts

Olcese et al. Energy Fuels 27 (2013) 2135

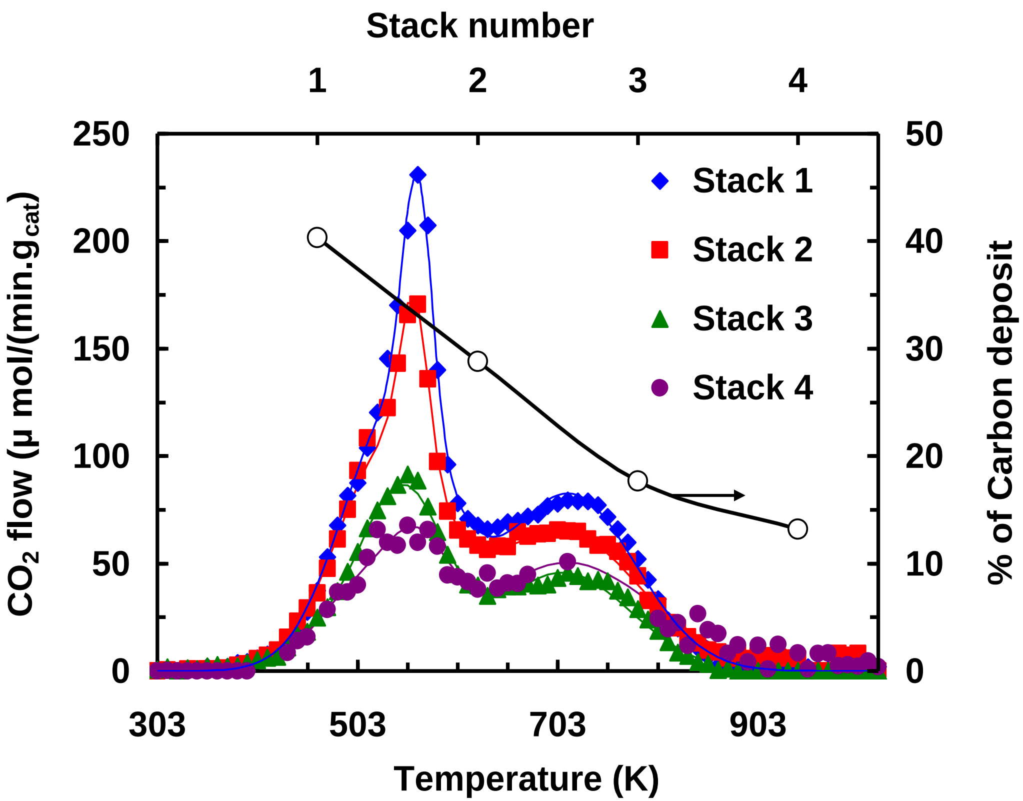


GC*GC and high resolution mass spectrometry (« Petroleomic ») are complementary methods

GC for light, petroleomic for heavier species

Olcese et al. Energy Fuels 27 (2013) 2135

Coke formed by real lignin vapours is very different than coke from guaiacol HDO

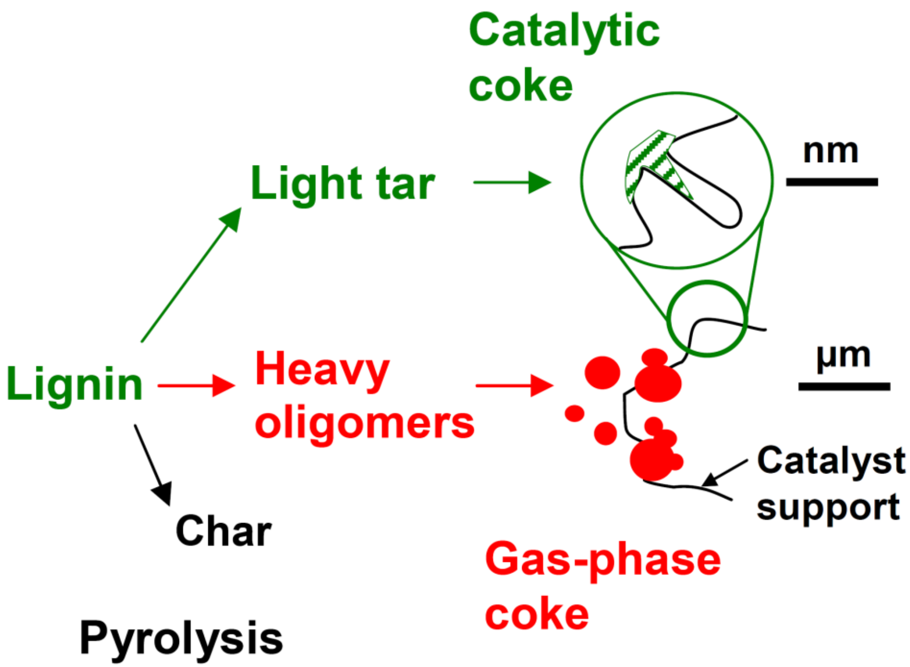


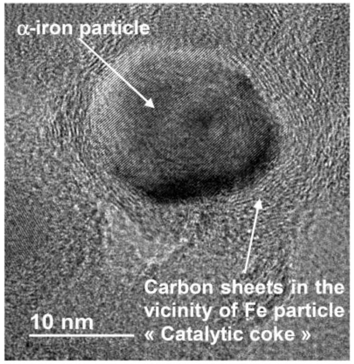
Coke analysed along the length of the fixed bed (profile in coke composition)

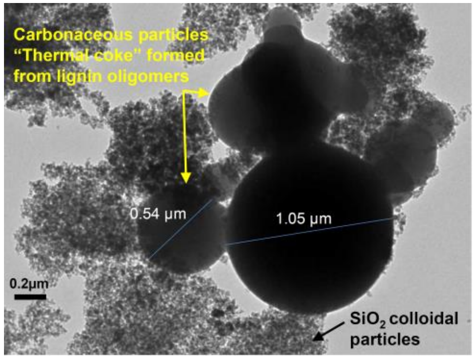
Coke plugged micropores of activated carbon but not mesopores of silica

Olcese et al. ChemSusChem, in press

The mechanism of coke formation during the HDO of real vapours has been revealed







TEM, TPO, Petroleomic, GC*GC, N_2 sorption (etc.) were used to reveal this mechanism

Olcese et al. ChemSusChem, in press

Iron is a selective and cheap catalyst for the HDO of lignin into aromatics

Works are conducted from molecular mechanisms to process integration

Thank you for your attention

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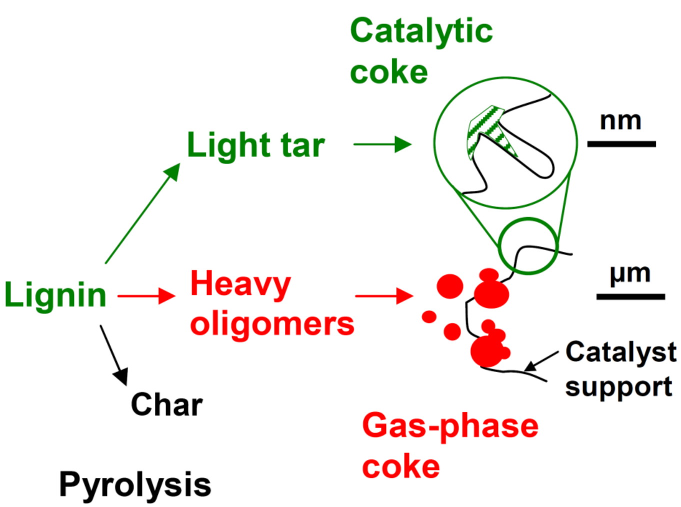


Related papers

1. **Olcese et al., Applied Catalysis B 115-116, pp. 63-73, 2012.**

   Effect of temperature, H_2 pressure and contact time on guaiacol HDO over Fe/SiO_2

2. **Olcese et al., Applied Catalysis B 129, pp. 528-538, 2013.**

   Effect of iron loads, support type (SiO_2 or carbon) and gas composition on guaiacol HDO

3. **Olcese et al., Energy and Fuels 27 (2), pp. 975-984, 2013.**

   Kinetics and Aspen Plus model of integrated lignin to BTX process

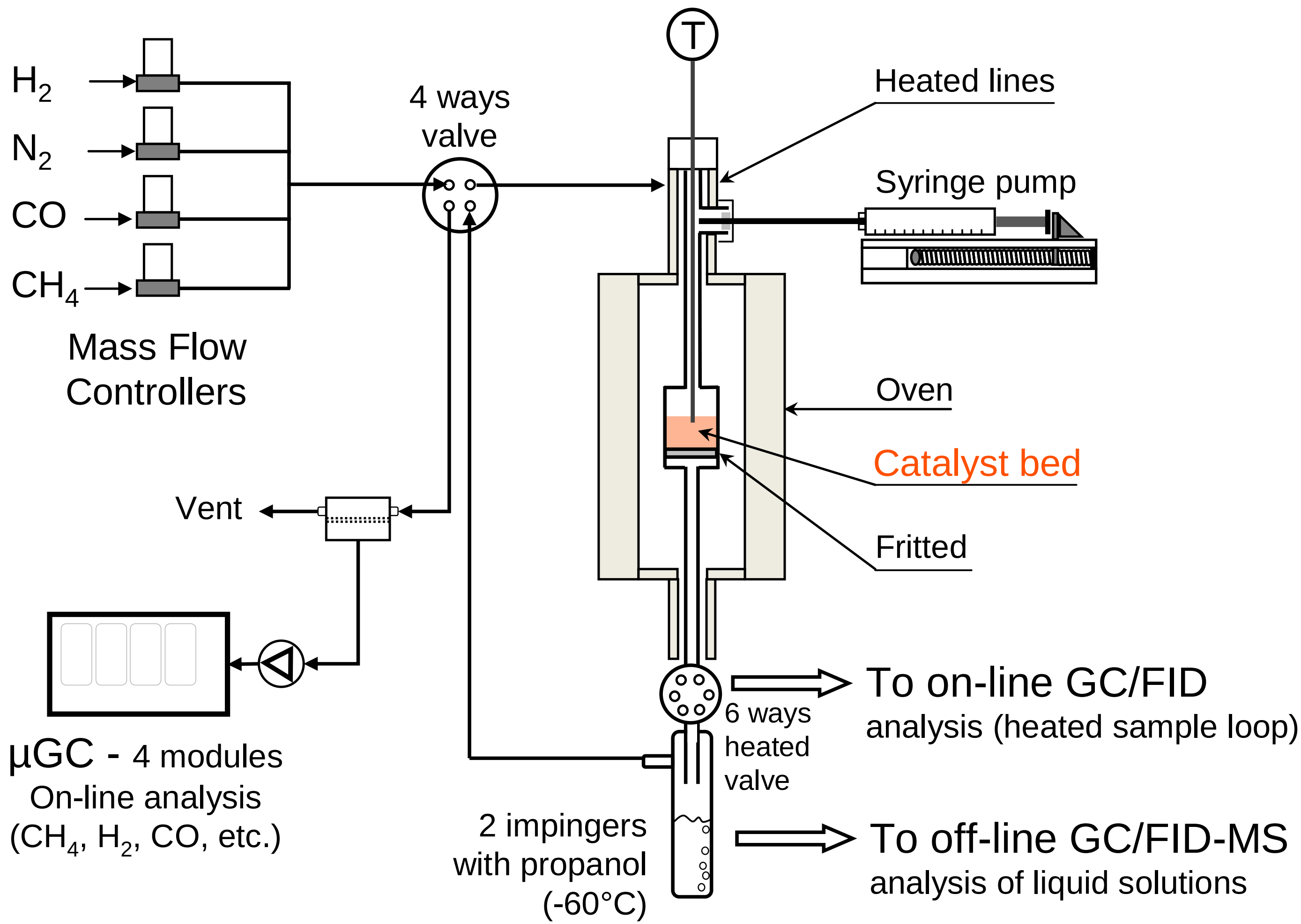
4. **Olcese et al., Energy and Fuels 27 (4), pp. 2135-2145, 2013.**

   GC*GC and petroleomic analysis on real lignin vapours HDO

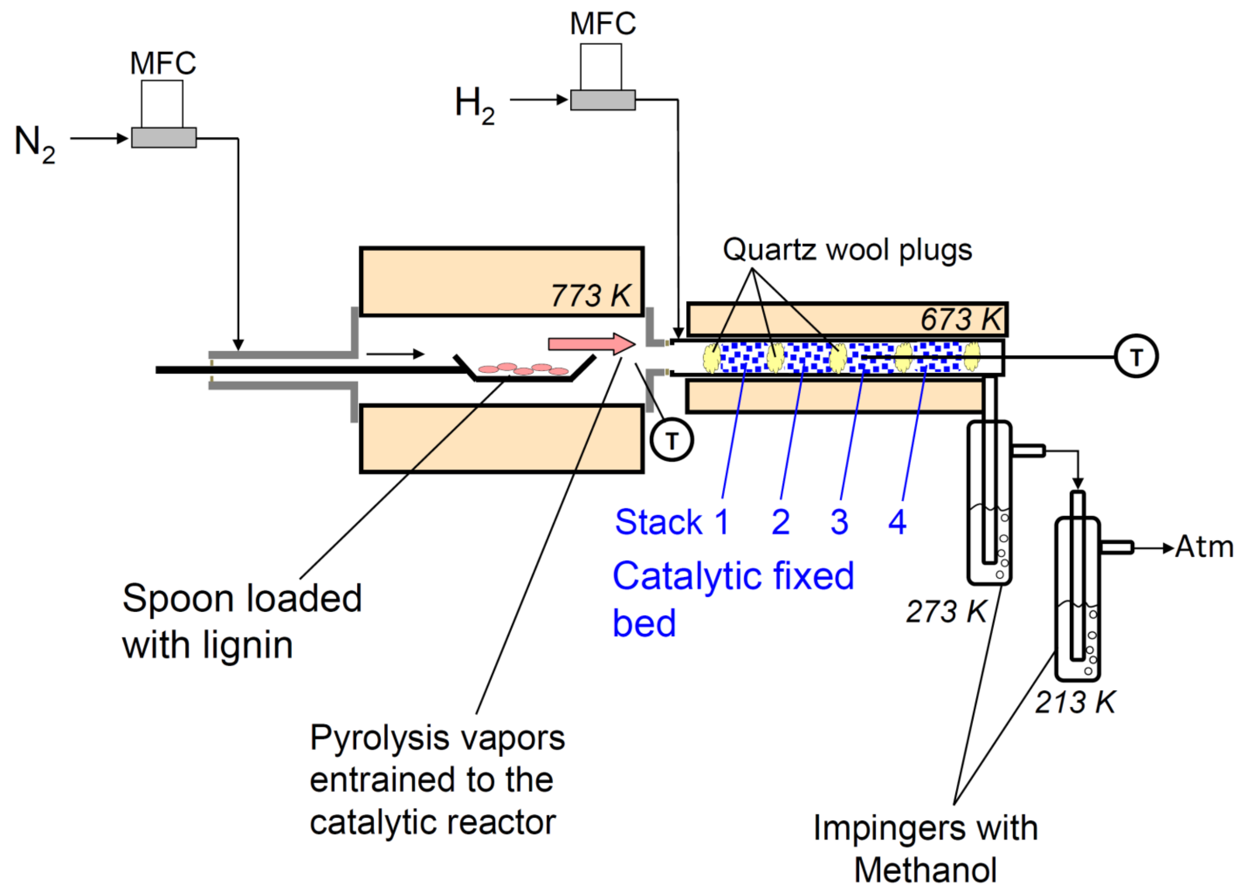
5. **Olcese et al., ChemSusChem, in press**

   Mechanisms of HDO of real lignin vapours over Fe/SiO_2 and Fe/activated carbon, deactivation and coke formation

Simplified scheme of the experimental set-up for guaiacol HDO over a fixed bed of catalyst



Simplified scheme of the experimental set-up for real lignin vapours HDO



Batch lignin pyrolysis connected to an horizontal fixed bed of catalyst, with stacks to investgate the profile of coke deposit along the fixed bed length