ON THE REACTIVITY OF MONO-LIGNOL DERIVATIVES

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### Introduction

- Depleting petroleum sources
- Rising energy demands
- Environmental concerns

**Products:** Bio char | Bio oil | Non condensable gases

#### Lignocellulosic Biomass

- Most abundant
- No competition with food supply
- Wood, plants, crops, algae
- Mainly C, H, O as cellulose, hemicellulose & lignin

#### Fast Pyrolysis

- Thermal decomposition in the absence of oxygen
- Temperatures of 500 – 900°C in a few seconds
- Most promising method for bio oil production

**Fast Pyrolysis**

- Fuel
- Fine chemicals

### Motivation

- **Purpose:**
  - Comprehensive and quantitative analysis of fast pyrolysis product distribution of polymers incl. biomass
  - Determination of intrinsic rate coefficients for solid to gas transition
  - Investigation of gas phase reactions of solid model components at isothermal conditions

**Purpose**

- **Analytics section**
  - Customized Trace GC 1310 with 3 Detectors
    - TCD-1
    - Water: formaldehyde
    - TCD-2 and PDD: permanent gases incl. H₂ and CO₂ - components
  - GC×GC - FID/TOF-MS
    - Simultaneous identification and quantification

**Analytics section**

- **Conclusions**
  - The micro-pyrolyzer setup offers a unique opportunity to study solid and gas phase chemistry of several lignin model compounds
  - Qualitative and quantitative analysis can be performed with the GCxGC-FID and TOF-MS

**Conclusions**

- **Future work**
  - Further investigate vaporization/gasification of ferulic acid and the other model compounds
  - Study the influence of a vinyl group on the reactivity as a function of temperature by comparing the lignin compounds phenol, guaiacol and syringol to their vinyl counterparts
  - Investigate the influence of the presence of a methyl ester on reactivity
  - Obtain complete experimental data sets to develop a kinetic model

### Model compounds

- **Products:**
  - Hydroybenzene
  - guaiacol
  - ferulic acid
  - Aromatic acid
  - Vinyl group
  - Acrylic acid ester group

#### Preliminary results for ferulic acid

- **Gasification at low temperatures**
  - Successful generation of short/long pulses of gas phase species
  - Allows to control the ratio between uni- and bi-molecular chemistry in the 2nd reactor

**Gasification at low temperatures**

- **Pyrolysis at high temperatures**
  - Decomposition, not vaporization
  - The decomposition is clean and quantitative – no ferulic acid signal detectable
  - Use ferulic acid as precursor to study 4-vinyl guaiacol pyrolysis chemistry

**Pyrolysis at high temperatures**

- **Future work**
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