Catalytic fast pyrolysis of biomass using Pyrolysis (Py)-GC/MS
Part 1: Lignin

[Background] Pyrolysis is recognized as a technique well suited to the production of valuable chemicals from waste plastics and biomass. This report describes fast pyrolysis (FP) and catalytic fast pyrolysis (CFP) of lignin, one of the main components of lignocellulosic biomass, using a Py-GC/MS system.

[Experimental] A Py-GC/MS system in which a Multi-Shot Pyrolyzer (EGA/PY-3030D) was directly interfaced to the GC injector was used. Approximately 0.1 mg of powdered lignin was put in a sample cup. The cup was placed in the pyrolyzer and purged with helium. The cup was then dropped into the furnace heated at 500 ºC. The products (pyrolyzates) were temporarily cryo-trapped at the head of a separation column using a MicroJet Cryo-Trap (MJT-1035E). The pyrolyzates were separated and detected by a mass spectrometer. For CFP, an identical analysis was conducted with 0.1 mg of lignin mixed with 2.0 mg of ZSM-5 catalyst (particle size 20 - 100 µm, SiO_2/Al_2O_3 ratio = 150).

[Results] Fig. 1 shows a pyrogram of lignin obtained using flash pyrolysis and a chromatogram of the products formed by the pyrolysis of lignin with ZSM-5 catalyst. Without catalyst, fast pyrolysis of lignin produces phenol derivatives such as guaiacol and syringol, both formed upon the thermal degradation of monolignol. When the ZSM-5 catalyst is present during the pyrolysis process, aromatic compounds such as benzene, toluene, and xylene are obtained by CFP. Aromatic hydrocarbons are of great value to industry who use these as feedstock for a wide variety of products.

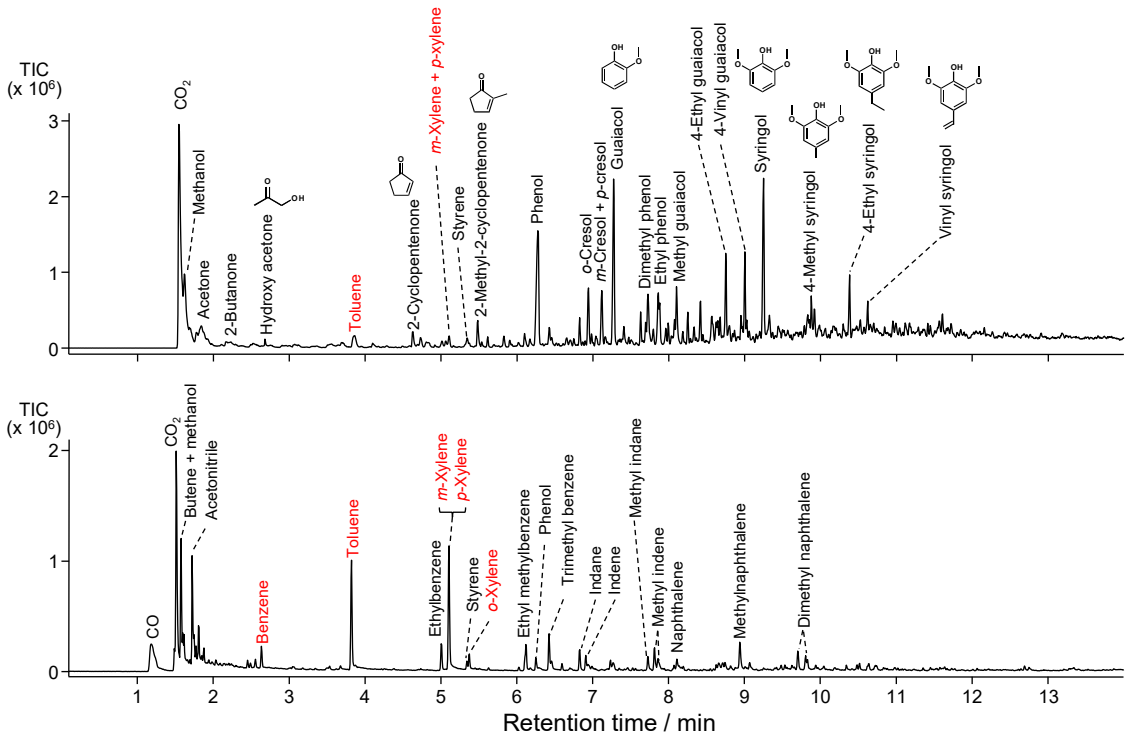

Fig. 1 Top: Pyrogram of lignin, Bottom: Chromatogram of catalytic reaction products of lignin

Pyrolysis/reaction temp.: 500 ºC, GC injector temp.: 300 ºC, GC oven temp.: 40 (2 min hold) - 320 ºC (20 ºC/min)
Separation column: UA⁺-5 (5 % diphenyl 95 % dimethylpolysiloxane), *L*=30 m, i.d.=0.25 mm, df=0.25 µm
Column flow rate: 1 mL/min (He), Split ratio: 1/50, Scan range: *m/z* 25 - 600, Scan rate: 2.56 scan/s
Sample amount: ca. 0.1 mg, Catalyst: ZSM-5 ca. 2.0 mg

Keywords : Biomass, Lignin, Pyrolysis-GC/MS

Product used : Multi-functional Pyrolyzer, MicroJet Cryo-Trap, UA⁺-5, Vent-free GC/MS adapter

Applications : Biomass, Catalyst evaluation

Related technical notes : RXA-003E, RXA-006E, PYA1-113E (Part 2)

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