Catalytic fast pyrolysis of biomass using Pyrolysis (Py)-GC/MS
Part 2: Cellulose

[Background] In the previous report (PYA1-112E), lignin was used as a biomass model sample, and the difference in pyrolysis products with and without catalyst was described. In this report, fast pyrolysis (FP) and catalytic fast pyrolysis (CFP) of cellulose, one of the components of lignocellulosic biomass, are described.

[Experimental] In the FP and CFP experiments, 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 cellulose was put in a sample cup and dropped into the furnace heated at 500 ºC. The products were temporarily cryo-trapped at the head of a separation column using a MicroJet Cryo-Trap (MJT-1035Ex). The pyrolyzates produced by FP were separated and detected by the GC/MS system. CFP was conducted by using 0.1 mg of cellulose mixed with 2.0 mg of ZSM-5 catalyst (particle size 20-100 µm, SiO_2/Al_2O_3 ratio = 150) under the same experimental conditions as the above FP study.

[Results] Fig. 1 shows a pyrogram of cellulose obtained by FP and a chromatogram of products formed by CFP of cellulose with ZSM-5 catalyst. Without catalyst, FP of cellulose produces levoglucosan as a major product, and the formation of other furans and aldehydes is also recognized. On the other hand, from the chromatogram of the catalytic reaction products of cellulose, it can be easily seen that valuable aromatic hydrocarbons such as benzene, toluene, and xylene are generated by CFP.

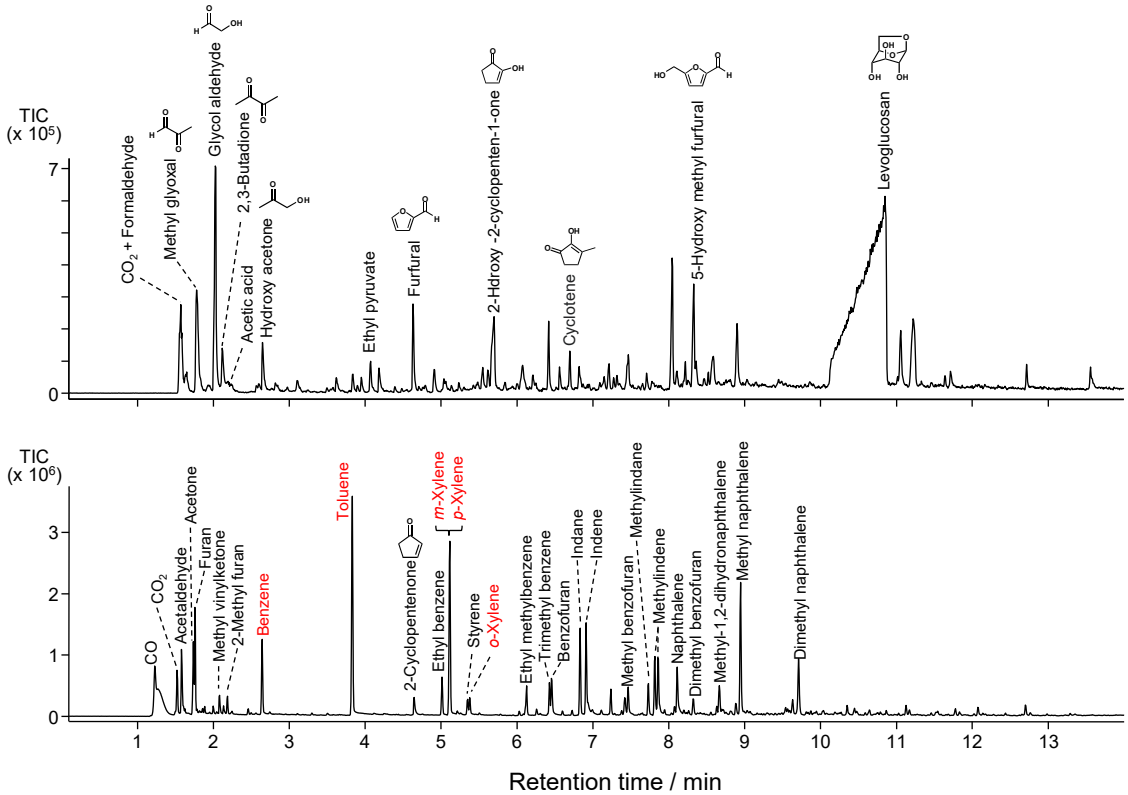

Fig. 1 Top: Pyrogram of cellulose, Bottom: Chromatogram of catalytic reaction products of cellulose

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 scans/s
Sample amount: ca. 0.1 mg, Catalyst: ZSM-5 ca. 2.0 mg

Keywords : Biomass, Cellulose, 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, PYA1-112E (Part 1)

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