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Characterization of pyrolysis of polymers by TG-MS

Introduction

When passed through a cooling trap and a reheating process, the evolved gases are strongly influenced by the thermal hysteresis though the characterization of pyrolysis of polymers has been utilized traditionally by pyrolysis gas chromatography / mass spectrometry (Pyrolyzer: Pyrolysis GC/MS). Therefore, it is difficult to say that the evolved gases from the sample are traced accurately because the activated gas components evolved with pyrolysis may be stabilized or changed by the thermal hysteresis.

ThermoMassPhoto system (TG-DTA-PIMS) equipped with both of the skimmer interface and the soft-ionization technologies becomes the most effective technique for characterization of pyrolysis of the material to enable the evolved gas distinguishing in real time and the influence of the thermal hysteresis to be negligible¹.

Example of measurement and analysis

Nylon is a polyamide including the aliphatic frame that united by the amide bond a lot of monomer. Figure 1 shows a comparison between the results of the EIMS and the PIMS for pyrolysates of Nylon 12 obtained by TG-DTA-EI/PIMS.

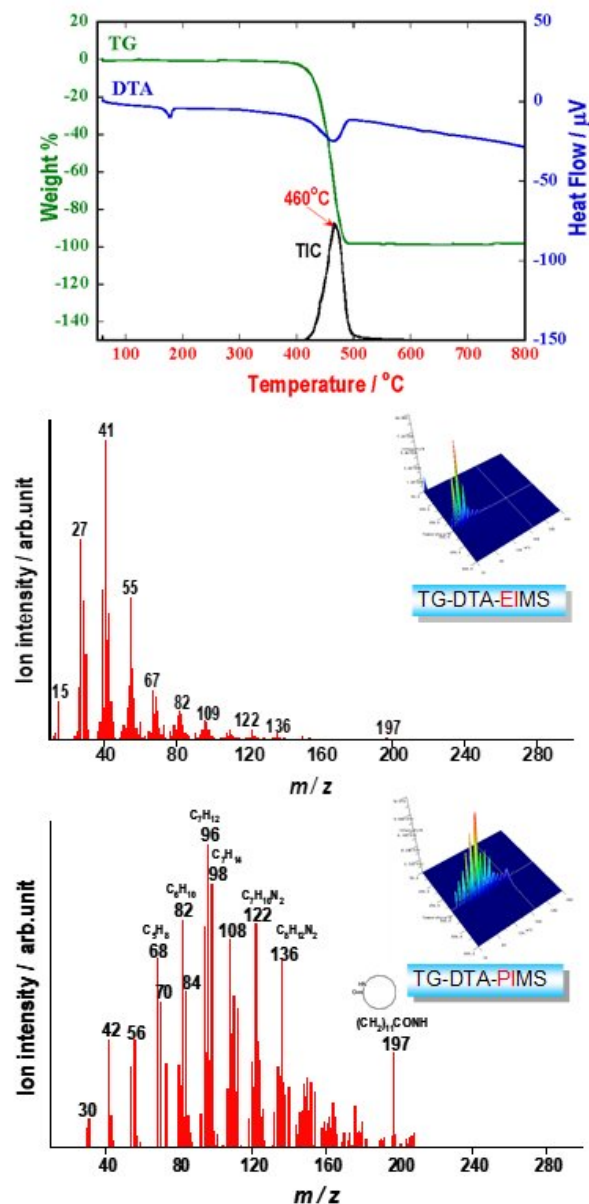


Figure 1: Comparison of the results of TG-DTA-EI/PIMS for Nylon 12 in helium atmosphere. Top: TG and TIC(EI) curve; Middle: EI mass spectrum at 600°C ; Bottom: PI mass spectrum at 600°C

It is difficult to characterize individually each pyrolysate by using a traditional electronic impact ionization (EI) method that overlap mutually the fragment ions of the pyrolysates in the lower m/z region. On the other hand, the PI method controls the fragmentation of molecules during the ionizing, and the resulting pyrolysates are directly detected as the molecular ions that originate to the structure of Nylon12. Therefore, identification of the pyrolysates becomes possible directly on the apparent mass spectrum. As the result, lauryllactam of m/z 197 that is the monomer in the PI method are plainly characterized in the mass spectrum.

Thus, the characteristic of fragment-free PIMS can catch sensitively the minute changes between the samples and is useful as the direct identification tool of the sample.

Reference

[1] T.Arii, S.Otake, "Study on thermal decomposition of polymers by evolved gas analysis using photoionization mass spectrometry (EGA-PIMS)", *J. Therm. Anal. Cal.*, **91** (2008) 419-426.

Related products



ThermoMass Photo

An integrated thermal analysis instrument capable of high-precision mass analysis of evolved gases without breaking the molecules, allowing direct measurement.