Forensic Discrimination of Fibers by Evolved Gas Analysis and Library Search by F-Search

[Background] In the area of forensic chemistry, the identification of an 'unknown' fiber needs to be done quickly and accurately; the analytical method needs to be as simple as possible. Evolved gas analysis (EGA)-MS is a simple thermal analysis method that provides information about the gases evolving from a sample as it is heated. This method provides information such as the elution temperature of the volatiles and the pyrolysis temperature of the unknown polymeric fraction of the sample. The thermal distribution of the evolved gases along with the mass spectra data, enables the analyst to quickly identify an 'unknown' fiber. This technical notes describes how EGA-MS can be used to compare different types of fibers.

[Experimental] The 21 fiber samples used in this study are shown in Fig. 1. Thermograms of these fibers were obtained by EGA. Then a library containing the average mass spectra of the main peaks in each thermogram was created using F-Search. The 21 fibers were differentiated based up on the thermal distribution of the evolved gases (i.e. the peak shape of the thermograms) and the F-Search library search results.

[Results] One of the 21 fibers was randomly selected to serve as the 'unknown' sample. The 'unknown' samples was then searched using the newly created library. In Fig. 2, the three candidates with highest match qualities are shown. Candidates 1 and 2 have match qualities greater than 80, but their mass spectra are too similar to differentiate them. However, candidate 2 has two main peaks in its thermogram and is much different than the thermogram of the unknown. Candidate 1, polyester, had a mass spectrum and thermogram quite similar to that of the unknown sample. When there is more than one candidate with similar thermogram profiles and average mass spectra, they can most likely be differentiated using Py-GC/MS (see PYA3-013).

• Natural fibers

Animal fibers…Wool, silk

Plant fibers…Cotton, hemp

• Synthetic fibers

Regenerated fibers…Cupra, rayon, polynosic

Semi-synthetic fibers…Acetate, diacetate, vinylon, promix

Synthetic fibers…Nylon 6, polyester (PET), polyester (blended), polypropyrene, polyethylene, acrylic, polyvinyl chloride, polyvinylidene chloride, polychlal

Fig. 1 Fiber samples used in this study

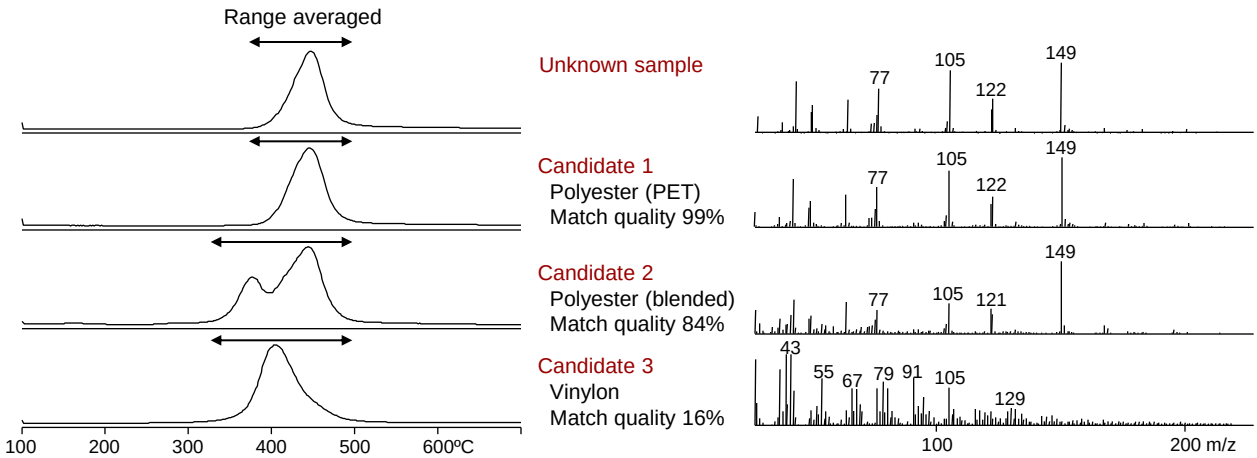

Fig. 2 Comparing the EGA thermogram and average mass spectrum of the "unknown" fiber with the three search candidates with the highest match quality

Pyrolyzer furnace temp.: 100 - 700ºC (20ºC/min), GC oven temp.: 300ºC, EGA tube: deactivated metal tube L=2.5 m, i.d.=0.15 mm
Column flow rate: 1 mL/min; He, split ratio: 1/50, sample: ca. 300 µg

Keywords : Fiber identification, Evolved gas analysis, EGA-MS, F-Search

Products used : Multi-functional pyrolyzer, Vent-free GC/MS adapter, F-Search, Deactivated metal capillary tube

Applications : Forensic investigation

Related technical notes : PYA1-016E, PYA3-006E, PYA3-013E

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