Novel Device for DART®-MS System ~ ionRocket ~

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Introduction

Direct analysis in real-time mass spectrometry (DART®-MS) is a powerful method for rapid analysis of mixtures. However, this method is often unsuitable for polymer analysis when samples are difficult to volatilize.

To overcome this disadvantage, we developed the ionRocket thermal desorption and pyrolysis device for DART®-MS (Fig. 1, 2). Elevating the temperature at a controlled rate releases vapor from the samples, which is then ionized and introduced into the mass spectrometer.

In this poster, we will describe analysis applications using ionRocket combined with DART®-MS.

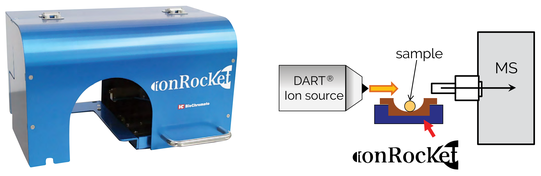

Fig.1 ionRocket

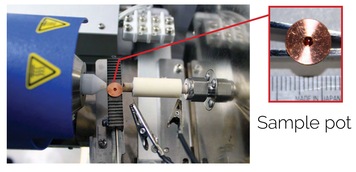

Fig.2 ionRocket combined with DART®-MS system

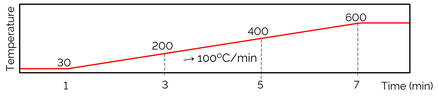

Fig.3 Example heating gradient for ionRocket

Application 1 THE IDENTIFICATION OF NYLONS

FT-IR is frequently used to identify types of polymers. However, FT-IR often fails to effectively differentiate between polymers with very similar structures, such as nylon types (Fig. 4).

In this application, three kinds of nylon were used as analysis samples. The nylon samples were cut into small pieces (0.5 mm x 0.5 mm) using a razor and placed in sample pot.

The samples were heated from ambient temperature to 600°C at a rate of 100°C/min (fig.3).

Ion source: DART®-SVP (IonSense, Inc.,)
Mass Spec.: micrOTOF-QIII (Bruker Daltonics, Inc.,)
Carrier gas: Helium, 3 L/min, 400°C

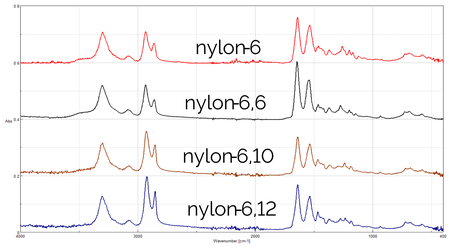

Fig.4. FT-IR spectra of nylons

EIC are shown in Fig.5. MS spectra measured at 400°C are shown in Fig.6.

In Fig.6, the monomers and dimers were mainly detected. Comparison of ionRocket EIC and DART®-MS spectra makes it possible to differentiate between nylon types.

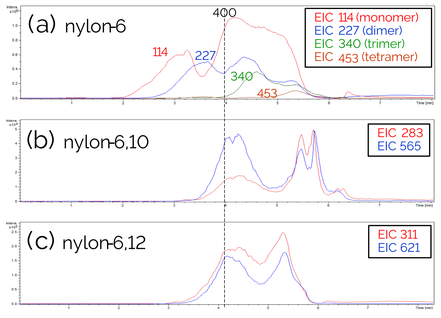

Fig.5 EIC of the ionRocket DART®-MS analysis of samples.
(a) nylon-6, (b) nylon-6,10 (c) nylon-6,12

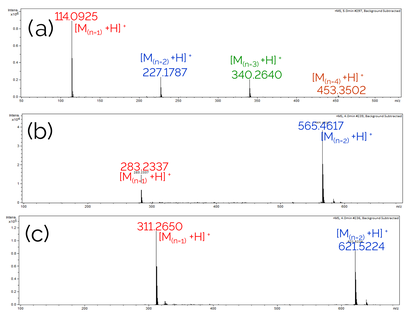

Fig.6 MS spectra of ionRocket DART®-MS analysis at 400°C
(a) nylon-6, (b) nylon-6,10 (c) nylon-6,12

Application 2 ANALYSIS OF DEGRADED RUBBER BANDS

Vulcanized rubbers contain several additives and different kinds of polymers; analyzing these components often requires extensive sample pretreatment. With ionRocket, we analyzed vulcanized rubber without any pretreatment.

New and degraded rubber bands were used as analysis samples. The samples were degraded (aged) by heating them for 30 minutes at 130°C. The rubber band samples were cut into small pieces (0.5 mm x 0.5 mm) using a razor, and placed in sample pot.

During analysis the samples were heated from ambient temperature to 600°C at a rate of 100°C min-1 (fig.3).

Three dimensional graphs are shown in Fig.7.

Figure 7 compares the new and aged rubber bands. Aging decreases the intensity of additive peaks and increases the intensity of peaks from degradation compounds formed from the polymer matrix.

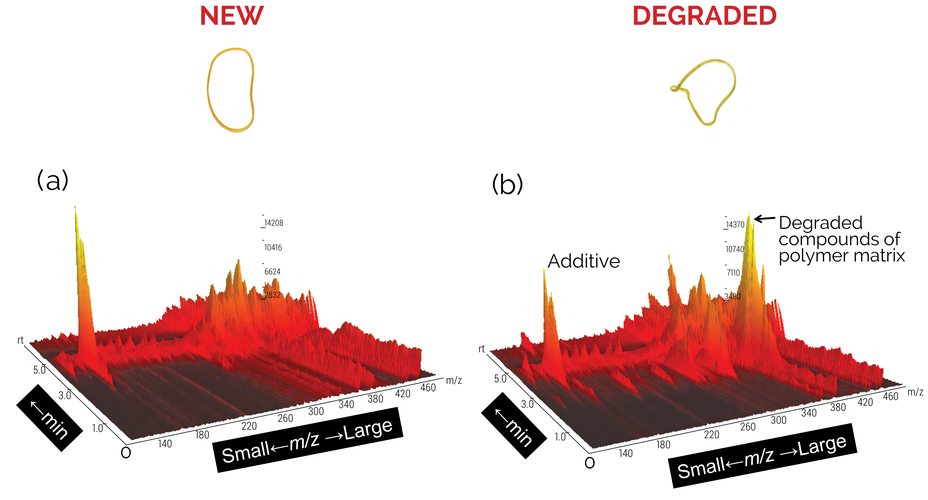

Fig.7 ionRocket DART®-MS analysis
(a) New rubber band, (b) Aged rubber band