Rapid analysis of an organo-molybdenum lubricating compound (Friction modifier for lubricating oils)

BN19-0419

BACKGROUND Lubricating oil is essential for machines and automobiles to operate properly and is an important component to achieve high performance and energy efficiency. Since lubricating oil contains various additives to improve function, analysis of those additives is frequently required. However, analysis of additives in lubricating oil is not easily carried out because of complicated pretreatment requirements. This application shows an example of analyzing an organo-molybdenum compound (a friction modifier for lubricating oils) using the ionRocket, showing that additive information can be obtained quickly and without any pretreatment.

SAMPLE Organo-molybdenum compound (Fig. 1, commercial product)

*Safety Data Sheet information: contains mineral oil, polyolefin amide alkene amine and Molybdic acid special mixed amine salt.

Fig. 1. Sample

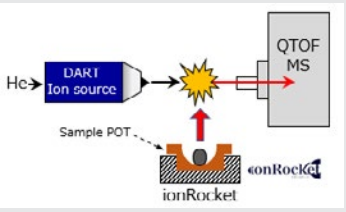

Fig. 2. ionRocket DART-MS® system

METHOD The ionRocket combined with quadrupole time-of-flight mass spectrometry (QTOF-MS) equipped with Direct Analysis in Real Time (DART®) was used as the analytical system for this application (Fig. 2). The sample (a few µL) was placed into the ionRocket sample POT. A temperature gradient of 100 /min. from room temperature to 600 was applied (total run time 7 min.).

RESULTS Observed species were submitted to an industrial additives mass spec database (Compound Search, BioChromato) and resulting matches are shown in Fig.3. This result implies that the sample also contains antioxidants and lubricants which are not listed on the SDS.

For species m/z 382.43 and m/z 564.63, there was no match in the additives database. Further analysis of the MS/MS spectra suggested the presence of a quaternary ammonium compound (Fig.4). In order to confirm the presence of the molybdic acid ion, measurement in DART® negative mode was carried out. The characteristic spectral pattern observed at 500~600 (Fig. 5) was compared with the theoretical spectral pattern of molybdic acid (Fig. 6), suggesting the presence of molybdic acid. As demonstrated above, ionRocket DART®-MS analysis is an effective means for rapid analysis of various additives in lubricating oils without any pretreatment.

It was confirmed that ionRocket combined with DART®-MS enables the detection of additives and base-resins contained in paints without any pretreatment or sample preparation. Therefore, this analytical method is useful for R&D and QC for paints.

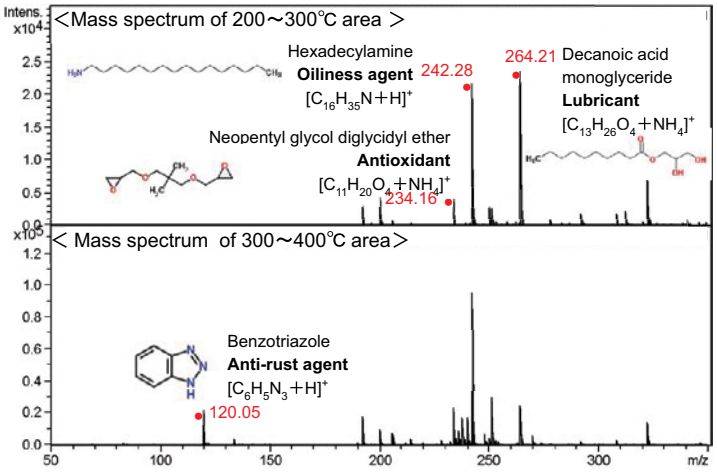

Fig. 3 Mass Spectrum
Top: 200~300°C Bottom: 300~400°C DART positive ion mode

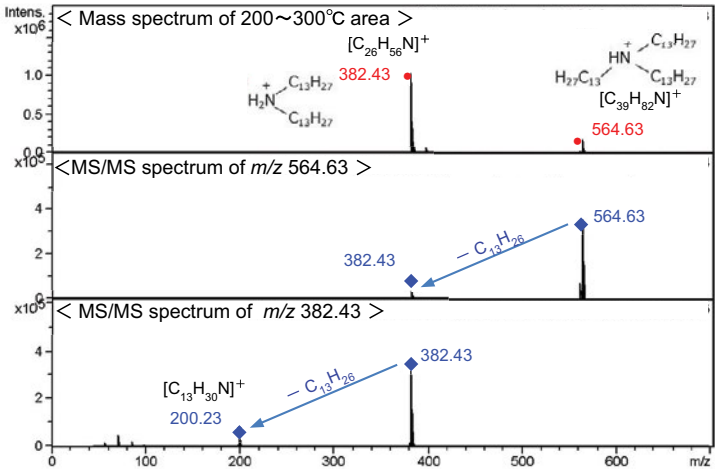

Fig. 4 Mass Spectrum and MS/MS Spectrum
200~300°C DART positive ion mode

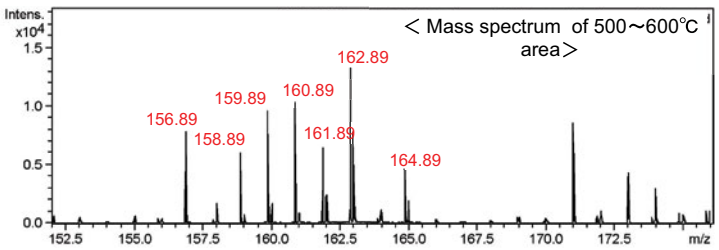

Fig. 5 Mass Spectrum
500~600°C DART negative ion mode

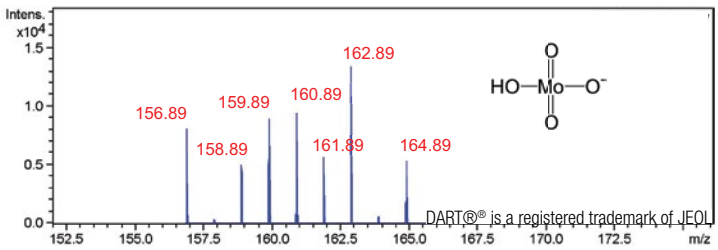

Fig. 6 Theoretical Spectral Pattern of Molybdic Acid ($HMoO_4^-$)