SCAS SINGAPORE
SCAS SINGAPORE PTE LTD

● Forecast Evaluation of Deterioration Generated by UV, Oxidation and Heat in Polymer in UV-Py-GC/MS

TNE0012

Overview

Polymer materials may deteriorate from the effects of light, oxygen and heat etc, and evaluation of weathering resistance tests taking these factors into account is most important. This paper introduces examples of the gases evolved during deterioration and qualitative information on the deteriorated materials from a combination of ultraviolet irradiation/pyrolysis/gas chromatograph mass spectrometry and evolved gas analyzer mass spectrometer (EGA-MS).

Method

UV-Py-GC-MS measurements	Measurement of gases evolved with and without UV irradiation
↓	
Comparison of chromatographs Identification of different components	Identification of different components by library search
↓	
EGA-MS measurements	Measurement of changes in thermal behavior after use as samples in UV-Py-GC/MS measurements

Example I: Confirmation of deterioration products of polystyrene

Figure 1 shows a chromatograph of measurements by UV-Py-GC/MS for polystyrene heated in air at 100° C with and without UV irradiation for 1 hour.

No deterioration products were found with UV irradiation off, but benzaldehyde and acetophenone were detected as the principal oxidative deterioration products with UV irradiation on. This was confirmed by the detection of these characteristics when styrene monomer was UV irradiated only.

These changes in the thermal behavior of polystyrene and normal polystyrene products under UV irradiation were confirmed by EGA measurements (Fig.2). They suggested the possibility of a fall in molecular weight due to UV irradiation and heating because of the 10° C downward shift in the peak top temperature in UV irradiated polystyrene.

Example II: Confirmation of deterioration products of ethylene vinyl acetate (EVA)

EVA film is used as a bonding and sealing film in solar cells. Figure 3 shows a chromatograph of measurements for EVA heated at 60° C with and without UV irradiation. Acetic acid was detected with UV irradiation, but not without, and the characteristics for aromatic compounds such as styrene, benzaldehyde, acetaldehyde, acetophenone and benzoic acid were also detected.

These results show that acetic acid is evolved through separation from the polymer side chains, and it was inferred that the aromatic compounds detected were due to the effects of oxidative deterioration on the additives contained in trace amounts in the polymer.

CO_2

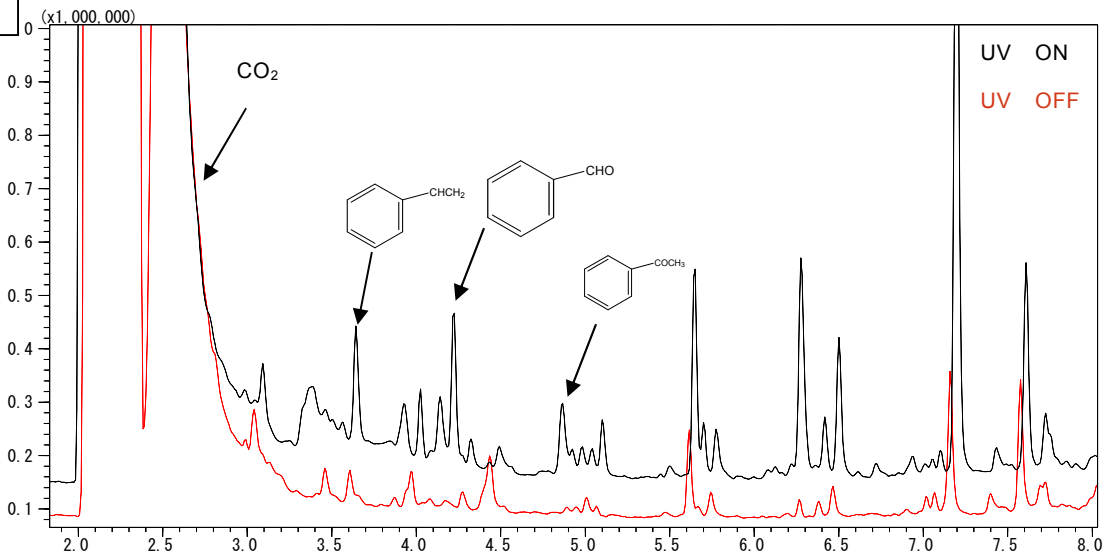

Fig.1 Results of UV-Py-GC/MS measurements of polystyrene (Example I).

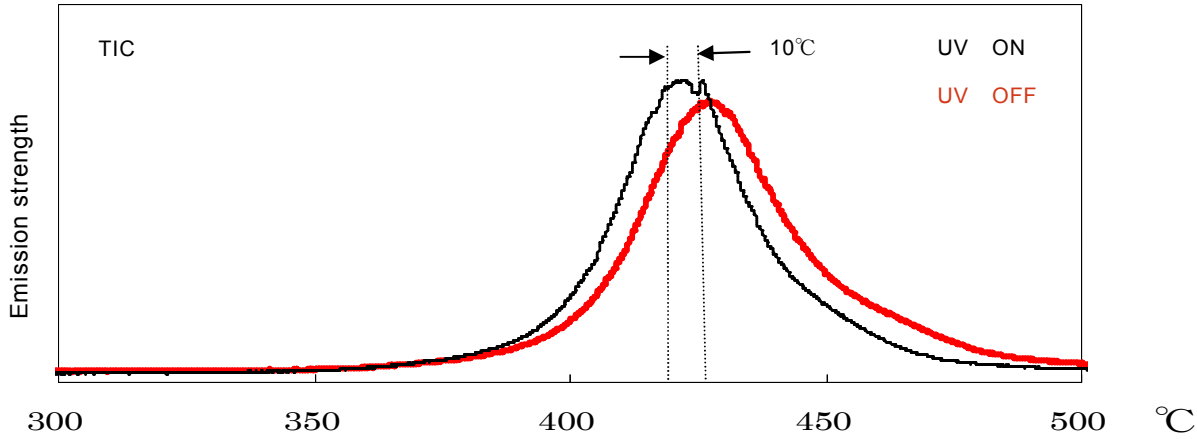

Fig.2 Results of EGA-MS measurements of polystyrene (Example I).

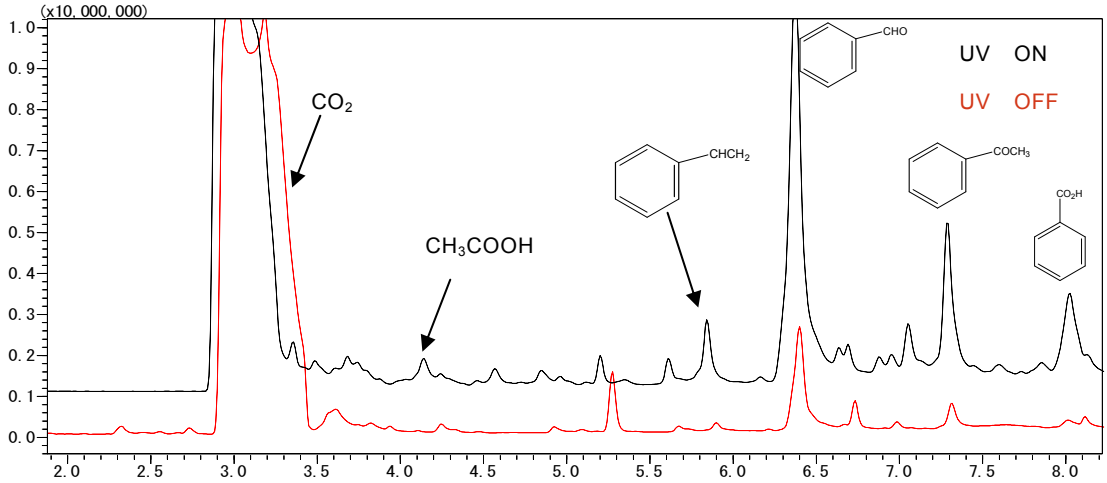

Fig.3 Results of UV-Py-GC/MS measurements of EVA (Example II).