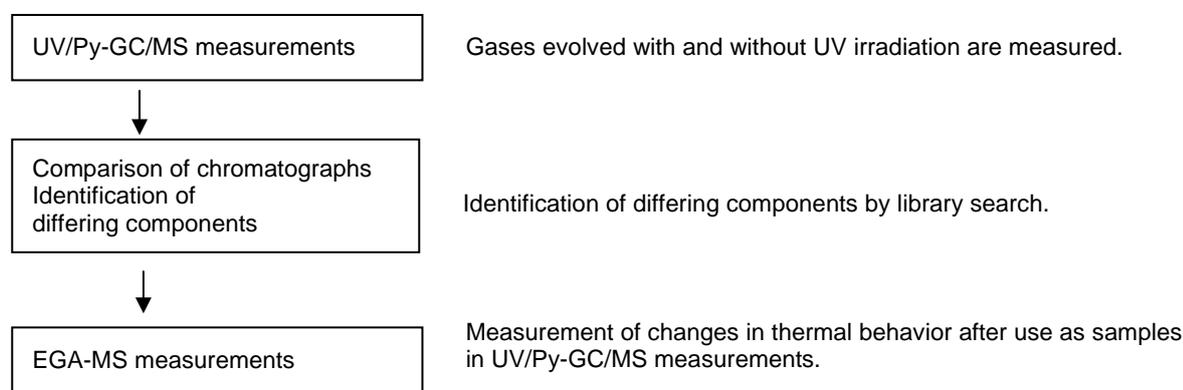


Forecast Evaluation of Deterioration caused by UV Exposure, Oxidation and Heat in Polymers by UV/Py-GC/MS

Overview

Polymer materials may deteriorate from the effects of light, oxygen and heat etc. Therefore in the evaluation of weather resistance tests, it is important to take these factors into account. Examples of gases evolved during deterioration and qualitative information on the deteriorated materials obtained by a combination of ultraviolet irradiation/pyrolysis-gas chromatography-mass spectrometry (UV/Py-GC/MS) and evolved gas analyzer-mass spectrometry (EGA-MS) are introduced.

Method



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.

Without UV irradiation, no deterioration products were found, but with UV irradiation, benzaldehyde and acetophenone were detected as the principal oxidative deterioration products. This was confirmed by the detection of these characteristics also seen only in styrene monomer evaluation with UV irradiation.

Thermal behavior of this UV irradiated polystyrene and untreated polystyrene were measured by EGA-MS (Fig.2). From the fact that the peak top temperature of UV irradiated polystyrene is shifted 10°C below, the possibility of a fall in molecular weight due to UV irradiation and heating can be suggested.

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 of EVA heated at 60°C with and without UV irradiation. Acetic acid was detected with UV irradiation, but not without, and the characteristic aromatic compounds such as styrene, benzaldehyde, acetaldehyde, acetophenone and benzoic acid were also detected.

From these results, it was inferred that acetic acid was evolved through desorption from the polymer side chains, and the aromatic compounds were detected due to the effect of oxidative deterioration of the additives contained in trace amounts in the polymer.

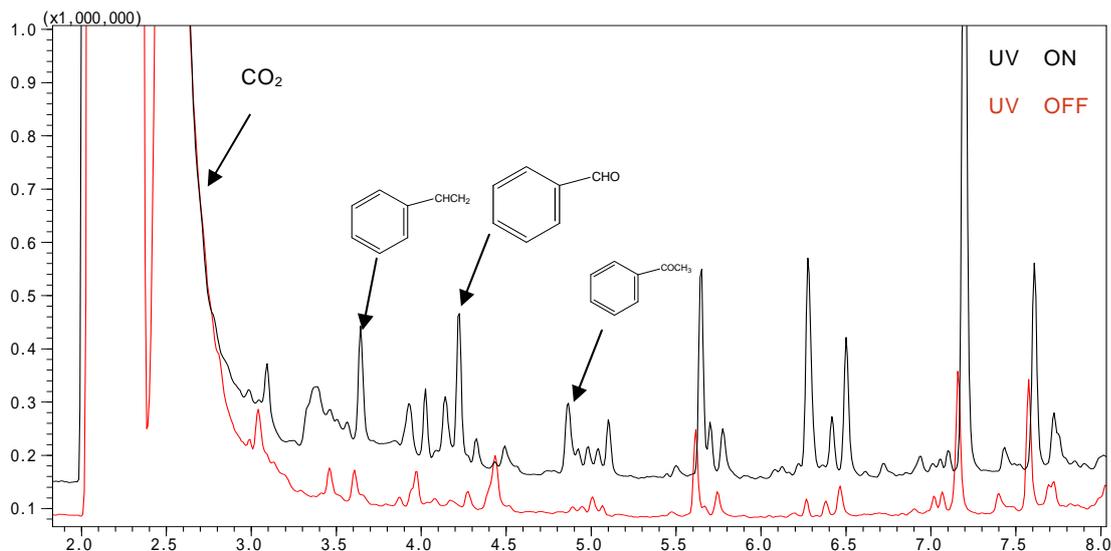


Fig. 1 Results of UV/Py-GC/MS measurements of polystyrene (Example I).

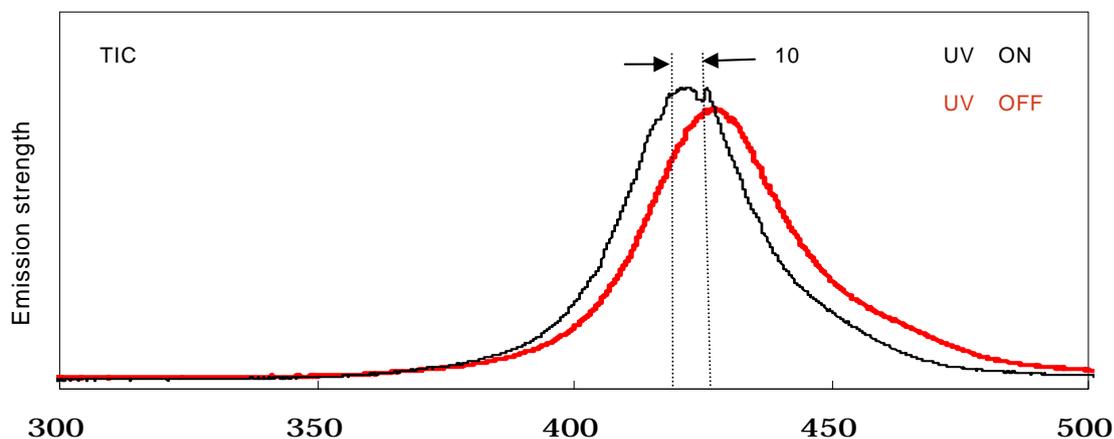


Fig. 2 Results of EGA-MS measurements of polystyrene (Example I).

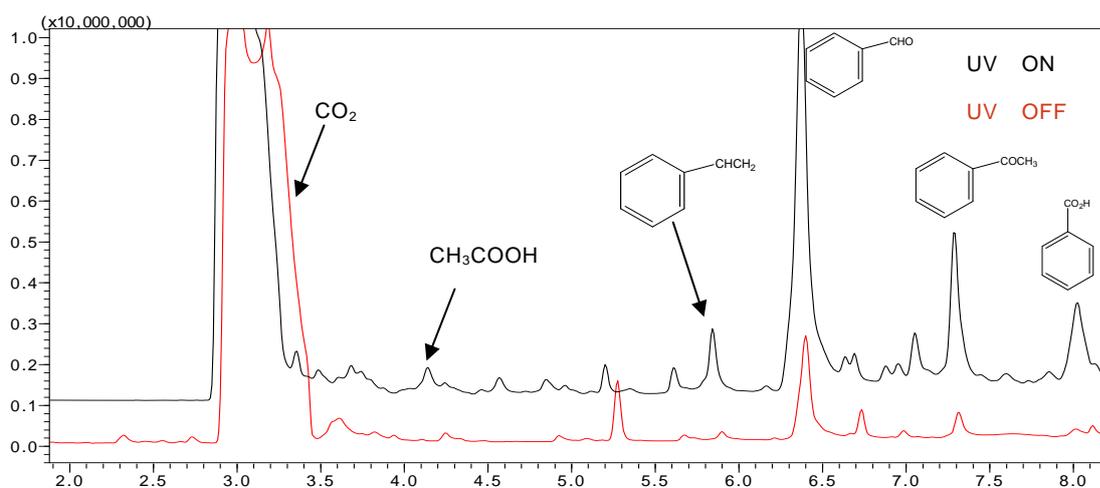


Fig. 3 Results of UV/Py-GC/MS measurements of EVA (Example II).

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