

OXIDATIVE DEGRADATION PRODUCTS ANALYSIS BY PYROLYSIS GAS CHROMATOGRAPHY-MASS SPECTROSCOPY*

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Pyrolysis gas chromatography-mass spectroscopy (PGC-MS) is proved to be a powerful method to analyze the small degradation fragments and the changes in macromolecular backbone during photo-oxidative degradation of polymers. 1) Different small molecules were found for different polymers. For example, n-alkanes with carbon number from 14 to 29 were detected in aged polyethylene (PE), while no oxidative product was found (shown in Fig.1) ^[1]. In contrast, various oxidative products could be found in aged polypropylene (PP) ^[2]. 2) The effects of inorganic fillers and chemical agents can be evaluated. For example, in nano-SiO₂ and nano-CaCO₃ filled PP, nanoparticles were demonstrated to accelerate the chain scission of PP, with more degradation fragments such as ketones, alcohols, esters and unsaturated species formed (shown in Fig.2). However, they did not change the photo-oxidation mechanism. In addition, the surface treatment of particles can also be characterized by PGC-MS. 3) Migration of additives in polymer can be detected. For example, migration of additives such as paraffins and antioxidants in Nitrile rubber (NBR) during aging can be monitored. And the crosslinking of the backbone can also be characterized by comparing the programs before and after aging. Therefore, PGC-MS can supply abundant information of photo-oxidation products and helpful for mechanism research.

References

1. Yang R., Yu J., Liu Y. *et al.*, Polym. Degrad. Stab. 88:333-340, 2005
2. Li J.F., Yang R., Yu J. *et al.*, Polym. Degrad. Stab. 93:84-89, 2008

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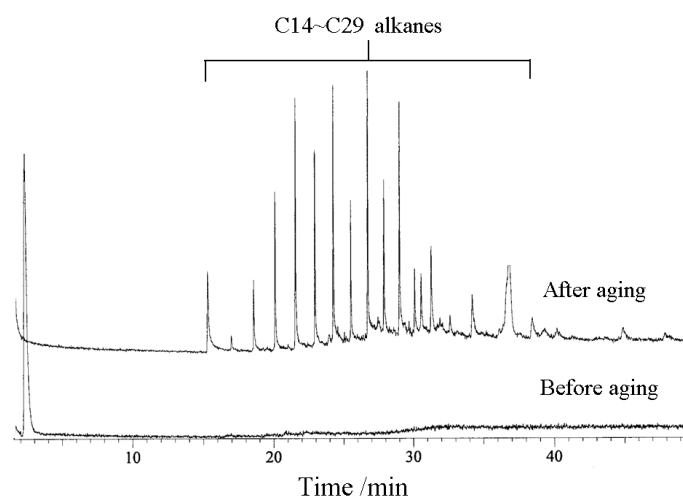


Figure 1 Volatile degradation products in polyethylene before and after aging.

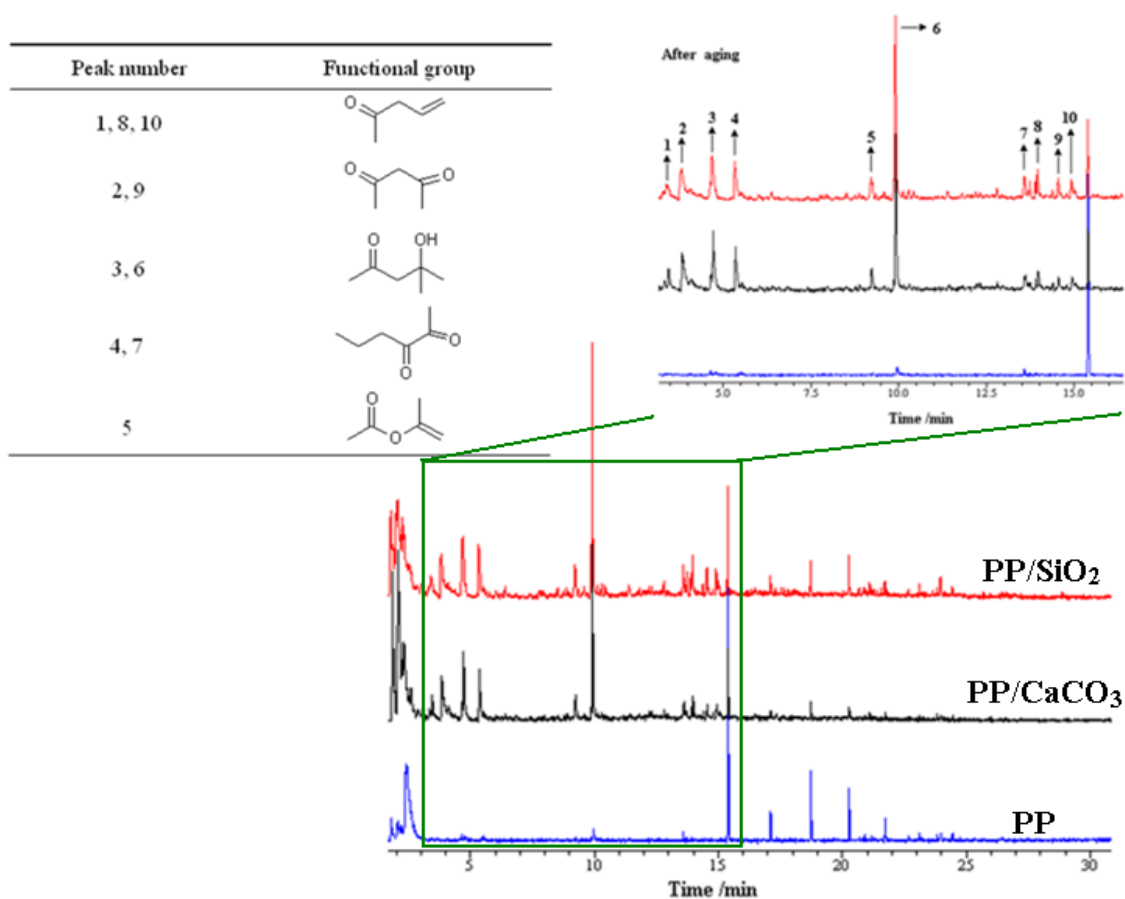


Figure 2 Oxidative degradation products in PP nanocomposites.