

## PHYSICOCHEMICAL AND MECHANICAL IMPACTS OF ACCELERATED PHOTO-AGEING ON POLYCARBONATE CD-R SUBSTRATES

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Polycarbonate (PC) is a ductile polymer used in many industrial sectors such as automotive, medical or electronics [1]. Among these applications, PC is also used as a substrate for CD-R manufacturing [1]. Accelerated photo-ageing of PC in oxidative conditions ( $\lambda > 290\text{nm}$ ) is known to lead to chains scissions [2]. However, these modifications can not explain the formation of cracks and the global loss of PC ductility during irradiation. The aim of this study was to identify the molecular origin of this polymer embrittlement.

Mechanical, thermal and spectroscopic analyses were performed on irradiated PC samples in order to correlate the evolution of the chemical structure to the variations in the functional properties. Nano-hardness values were determined from indentation experiments performed by atomic force microscopy (AFM). The glass transition temperature was measured at a nanometric scale by AFM thermal analysis (Vita mode).

1. Brydson J.A., editor. *Plastics Materials Seventh Edition*. Oxford: Butterworth-Heinemann, 1999. p. 556-583.
2. Rivaton A., *Polym. Degrad. Stab.* 49:163-179, 1995.

The glass transition temperature was measured at the surface of PC under photooxidation (Figure 1) to understand the macromolecular changes involved in these mechanical evolutions. The decrease in nano-Tg observed for short irradiation periods reflects an increase in molecular mobility. This change in mobility can be attributed to scissions of the macromolecular “backbone”, which is consistent with the known photo-oxidation mechanism [2]. For longer irradiation periods, the increase in nano-Tg suggests a drop in molecular mobility, which can only be explained by cross-linking reactions.

Spectroscopic analyses were performed to characterize the chemical evolutions.

The correlation of the chemical analysis with the evolution of the mechanical properties of PC highlighted both chain cleavages and cross-linking reactions. This correlation allowed us to form a more complete photo-oxidation mechanism, which can explain the loss of polycarbonate ductility observed during photo-ageing. A new reaction pathway, which corresponds to a cross-linking reaction route, was added to the current photo-oxidation mechanism.

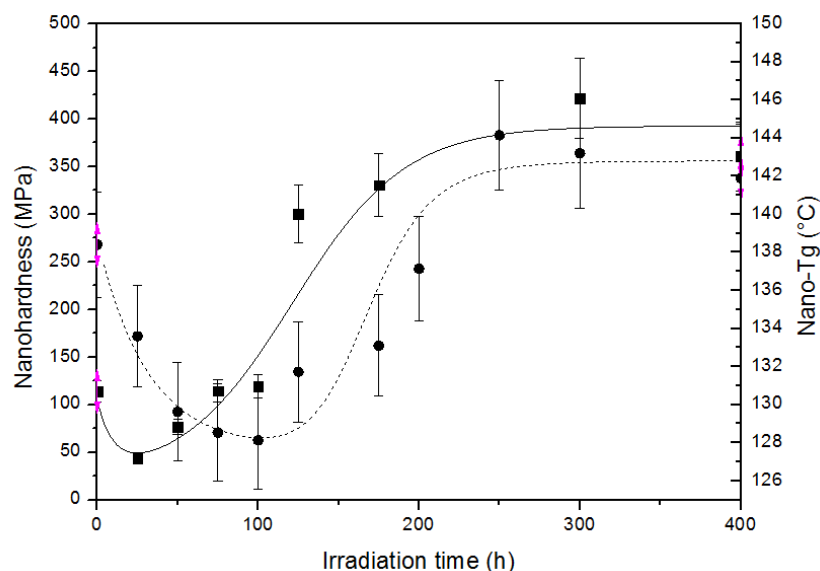


Figure 1: Nanohardness (■) and nano-Tg (●) evolution of polycarbonate substrate during irradiation