

PO1071

An EPR/ENDOR study of free radicals in X-ray and plasma irradiated polymer powders.Ignacio Caretti¹, Ignacio Jiménez², Sabine Van Doorslaer³¹Materials Science Institute of Madrid, Madrid, Spain ²Materials Science Institute of Madrid, Madrid, Spain ³University of Antwerp, Wilrijk, Belgium

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Free radicals, both as intermediate and stable paramagnetic species, are readily formed in polymers by means of ionizing radiation. The chemical changes induced in this way to the polymer result often in the modification of its properties, mainly through cross-linking, degradation and grafting mechanisms. Even though polymer irradiation with gamma rays, X-rays, UV light or high energy particles is regularly applied for many technological applications, identification of the radicals formed is still the subject of active debate.

In this work, we investigate x-ray irradiated polypropylene (PP), polyethylene (PE), polyamide nylon-6 (N6) and polyimide (kapton[®]) polymer powders prepared by cryogenic grinding at liquid N₂ temperature. In case of PP, a solution-precipitation procedure was also carried out to produce a powder with smaller particle size. The latter was surface-modified for 30s using N₂, O₂ and Ar plasmas created inside a low pressure radiofrequency plasma reactor.

Mainly continuous wave (CW) EPR/ENDOR methods have been reported for the study of organic radicals in irradiated polymers, while the corresponding pulsed techniques have been scarcely used. Here, we have exploited the combination of CW and pulsed X-band EPR, CW W-band EPR and X-band Mims ENDOR to explore the formation of alkyl and peroxide radicals by irradiation and probe the weak interactions with neighbouring protons, as well as nitrogens in N6 and kapton. Our results are examined in the context of currently available structural models for this type of radicals.

Keywords

EPR/ENDOR

polymers

free radicals

plasma treatment