EVIDENCE OF STRUCTURAL ORDER RECOVERY IN LDPE BASED COPOLYMERS PREPARED BY GAMMA IRRADIATION

L.M. Ferreira[1*], J.P. Leal[2], M.H. Casimiro[3], C. Cruz[1], A.N. Falcão[4]

[1] Unidade de Física e Aceleradores, Instituto Tecnológico e Nuclear, Instituto Superior Técnico, Universidade Técnica de Lisboa, E.N. 10, 2686-953 Sacavém, Portugal
[2] Unidade de Ciências Químicas e Radiofarmacêuticas, Instituto Tecnológico e Nuclear, Instituto Superior Técnico, Universidade Técnica de Lisboa, E.N. 10, 2686-953 Sacavém, Portugal
[3] REQUIMTE/CQFB, Departamento de Química, Faculdade de Ciências e Tecnologia, FCT, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
[4] Unidade de Reactores e Segurança Nuclear, Instituto Tecnológico e Nuclear, Instituto Superior Técnico, Universidade Técnica de Lisboa, E.N. 10, 2686-953 Sacavém, Portugal
[*] ferreira@itn.pt

The crystallinity of polymeric materials determines their physico-chemical and mechanical properties. For polymers modified by ionizing radiation, this parameter is especially important, given the capability of radiation to interact with the more intrinsic structure of the materials.

In the case of graft copolymers prepared by this route the crystallinity evolution of the copolymer backbone acquires an added importance. Crosslinking processes and molecular deformations caused by graft reaction, can be mechanically limiting, impairing the functional performance of the new material.

Thermal analysis techniques, namely *Differential Scanning Calorimetry – DSC*, due of its efficiency has become a fundamental tool in the study of phase transition temperatures, providing precious data about the structural organization of the matter. The melting enthalpy of a polymeric material is related with the energy required to break the intermolecular bonds, and can be used to evaluate its crystallinity. Thus, polymer chains more ordered, *i.e.*, more crystalline, have stronger intermolecular bonds and in greater number, and therefore, higher temperatures and enthalpies of fusion.

In our studies for optimization of PE-g-HEMA films preparation by gamma irradiation, it was observed the existence of a consistent correlation between the grafting degree and the crystallinity of the copolymers. Data showed evidences that the structural changes induced in polyethylene backbone depend strongly on the graft of poly(HEMA) and in what seems to be the reorganization of PE matrix amorphous regions.

Effectively these copolymeric films seem to have some capacity of structural order recovery above a certain radiation dose threshold. This fact was attested by the recovery of some crystallinity in films prepared with doses above 9 kGy.

FTIR analysis confirmed DSC data, revealing a slight increase in intensity and definition of the characteristic peak indicator of high crystalline regions in PE.

Since one of the applications for these materials, that is being tested, is their use as catalysts support in catalytic membrane reactors, this observed behavior is of major importance once give additional confidence of their structural stability besides the mechanical strength already observed in previous studies [1,2].

References.

1. Ferreira, L.M., Falcão, A.N., Gil, M.H. (2006), *Mat. Sci. Forum* **514-516**, 1034-1038.
2. Ferreira, L.M., Falcão, A.N., Gil, M.H. (2007), *Nucl. Instr. Meth.B* **265**, 193-197.

Acknowledgments.
This work has been supported by Fundação para a Ciência e a Tecnologia and Ministério da Educação e Ciência (PTDC/CTM-POL/114579/2009, PEst-C/EQB/LA0006/2011 and SFRH/BPD/26961/2006).