Proceedings of the 7th International Conference on Mechanics and Materials in Design,
Albufeira/Portugal 11-15 June 2017. Editors J.F. Silva Gomes and S.A. Meguid.
Publ. INEGI/FEUP (2017)

PAPER REF: 6859

CHARACTERIZATION OF MULTI-WALLED CARBON NANOTUBES REINFORCED ETHYLENE-OCTENE COPOLYMER COMPOSITES FOR DESIGN OF NOVEL HEAT SHRINKABLE MATERIALS

Remo Merijs Meri[1(*)], Janis Zicans[1], Ingars Reinholds[2], Tatjana Ivanova[1], Zhenija Roja[2], Robert Maksimov[3]

[1]Institute of Polymer Materials, Fac. of Mat. Sci. and Appl. Chemistry, Riga Technical University, Riga, Latvia
[2]Department of Chemistry, University of Latvia, Riga, Latvia
[3]Institute for Mechanics of Materials, University of Latvia, Riga, Latvia
[(*)]*Email:* remo.merijs-meri@rtu.lv

ABSTRACT

The work is devoted to development of novel heat shrinkable materials based on radiation modified ethylene-octene copolymer (EOC) - multi-walled carbon nanotubes (MWCNTs) composites. EOC/MWCNTs composites with desired heat shrinkable behavior (thermal relaxation stresses > 0.3 MPa and shrinkage stresses > 0.6 MPa), enhanced tensile properties and improved radiation resistance have been obtained. Specific structure-property relationships have been revealed, justifying the change of determined exploitation properties.

Keywords: nanocomposites, ethylene-octene copolymer, multi-walled carbon nanotubes.

INTRODUCTION

Metallocene catalyst synthetized polyethylene copolymers, including ethylene-octene copolymers (EOCs), represent the newest generation of thermoplastic polyolefine elastomers. Radiation modification of EOCs has shown to be useful (Bhowmick, 2006) for developing of cross-linked systems for applications in building and construction, medicine and other sectors of national economy. Considerable growth in modulus of elasticity and strength of EOCs has been observed along with rising irradiation dose, especially at elevated temperature (Perraud, 2003). Effectiveness of radiation modification of polymers, including EOCs, however, is prevented due to oxidation and chain scission of macromolecular chains. On this score, carbon nanotubes have found an application in radiation chemistry of polymers due to the ability to exert a radical scavenging activity because of the presence of acceptor-like localized states (Watts, 2003).

In the current research, investigations have been performed on the influence of ionizing radiation on the properties of thermoplastic composites based on EOC (with 17 % of 1-octene as ethylene co-monomer) modified with MWCNTs at broad concentration range (0-15 wt.%).

RESULTS AND CONCLUSIONS

It has been determined that radiation induced oxidation of the polymer is considerably decreased in the presence of MWCNTs confirmed by decrement of the value of carbonyl index (effective amount of MWCNT - 5 wt.%). The studies by infrared spectroscopy also confirm the rise of trans-vinylidene group relative absorbances at MWCNT concentrations up

to 5 wt.%, testifying about increment of cross-linking degree. Consequently, in the presence of MWCNTs gel fraction is increased probably due to structural changes in the polymer-nanofiller interface: MWCNTs are forming "bridges" between separate polymer macromolecules. In the result of radiation modification modulus of elasticity and strength of the investigated polymer composites are increased, while ultimate deformation is decreased.

It is worth of mentioning that gel fraction content of EOC/MWCNT compositions correlate with increase of shrinkage stresses up to the optimal filler content of 5 wt. %. For an example at this MWCNT content shrinkage stresses of EOC17 nanocomposite, irradiated up to the absorbed dose of 150kGy, increase up to 35%. Values of thermorelaxation stresses for the compositions increase up to 14% in comparison to neat EOC matrix, testifying about improved thermoshrinking properties of the nanocomposites.

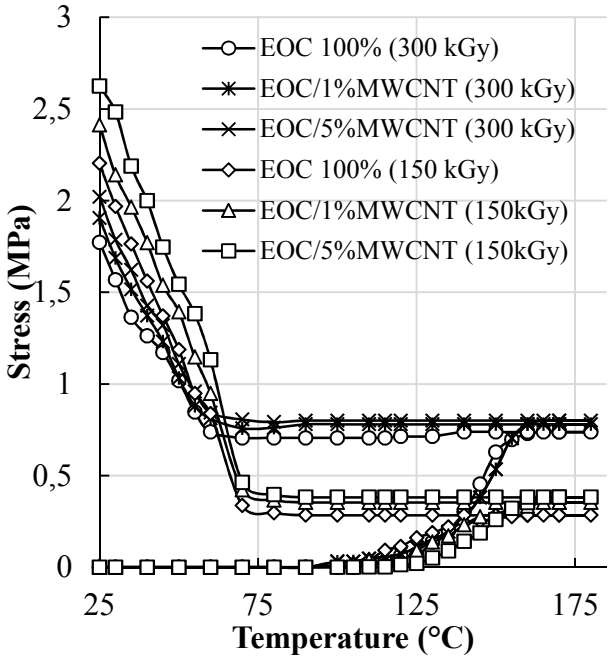

Fig. 1 - Thermoshrinking behavior of EOC/MWCNT nanocomposites at various doses of absorbed irradiation

ACKNOWLEDGMENTS

The authors gratefully acknowledge the funding by Ministry of Education and Science, Latvia, under National Research Program Mult**I**functional **M**aterials and compos**I**tes, photonic**S** and nanotechnology **(IMIS^2)**.

REFERENCES

[1]-Bhowmick AK, Vijayabaskar V. Electron Beam Curing of Elastomers. Rubber Chem. Technol., 2006, 79(3), p. 402-428.

[2]-Perraud S, Vallat MF, Kuczynski J. Radiation Crosslinking of Poly(Ethylene-Co-Octene) with Electron Beam Radiation. Macromol. Mater. Eng., 2003, 288, p. 117-123.

[3]-Watts PCP, Fearon PK, Hsu WK, Billingham NC, Kroto HW, Walton DRM. Carbon nanotubes as polymer antioxidants. J. Mater. Chem., 2003, 13, p. 491-495.