Radiochemical stability and life time of HDPE-based flexible composites filled with Ce-doped PZT $PbZrTiO_3$

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INTRODUCTION

The stability of polymers can be achieved by the addition of special inorganic filler, an oxide material doped with suitable atoms which narrows the energetic condition for electron jumping. Ce-doped $PbZrTiO_3$ was used as oxidation protector in HDPE. Our previous studied on this effect in polymers reveal the stabilization activity of this kind of additive in other polyolefins [1, 2]. The certain ability of radical scavenging is provided by the energy gap which allows the joint of free radicals on the network defects. The accelerated degradation under g-irradiation (up to 200 kGy) was applied for the strength testing.

EXPERIMENTAL

The comparison of pristine HDPE with hybrids, where filler have general formula: $Pb(Zr_{0.65-x}Ce_xTi_{0.35})O_3$, where x = 0.05 (C1), 0.075 (C2), 0.1 (C3) and 0.125 (C4). Two concentrations of inorganic phase (3 and 5 %) were prepared.

Complementary investigations on the Ce-doped PZT $PbZrTiO_3$ were used:

– Chemiluminescence spectroscopy (LUMIPOL 3, Slovakia). Isothermal (190 ^oC) and nonisothermal procedures (temperature range: 25-250 ^oC) were used .

-- Thermal analysis (STA 449 Jupiter provided with korund a-alumina crucible). Oxygen flow rate: 50 mL min^{-1}. Heating range: RT 25–600 ^oC

-- XRD analysis (Brookhaven 90 Plus, USA)

-- Granulometry (Fritsch Particle Sizer Analysette) The particle size distributions of the compositions PZTC1 after calcining at 920 ^oC for 4h and grinding 13 hours. ^oC

RESULTS AND DISCUSSION

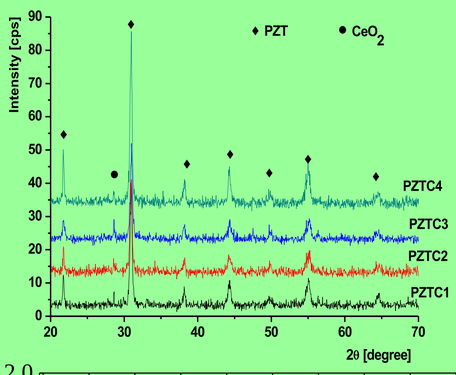

Fig. 1. XRD patterns of the powders PZTC1-4 after calcinated at 920 ^oC for 4h and grinding 13 hours

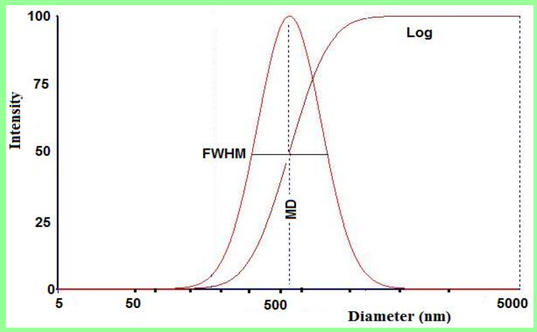

Fig. 2. Particle size distribution of PZTC1 after calcinated at 920 ^oC for 4h and grinding 13 hours

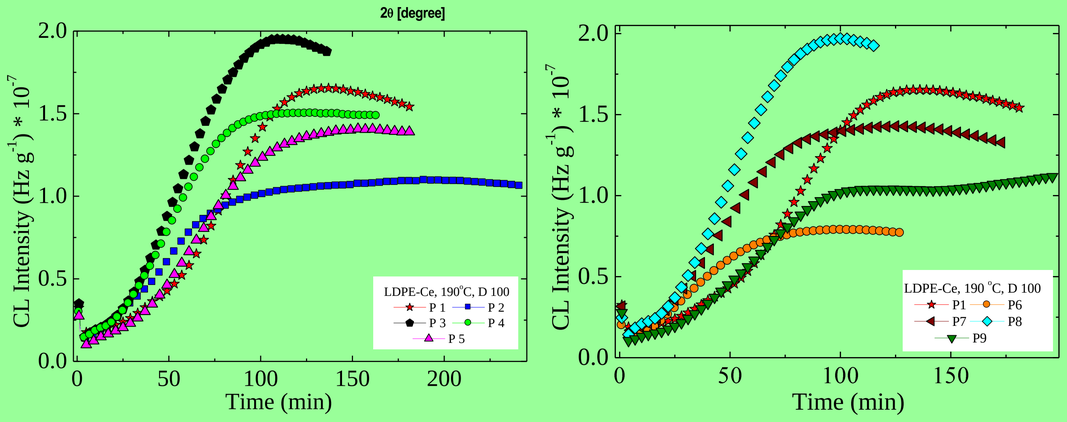

Fig. 3. Isothermal chemiluminescence spectra recorded on LDPE/ Ce-doped $PbZrTiO_3$ irradiated at 100 kGy

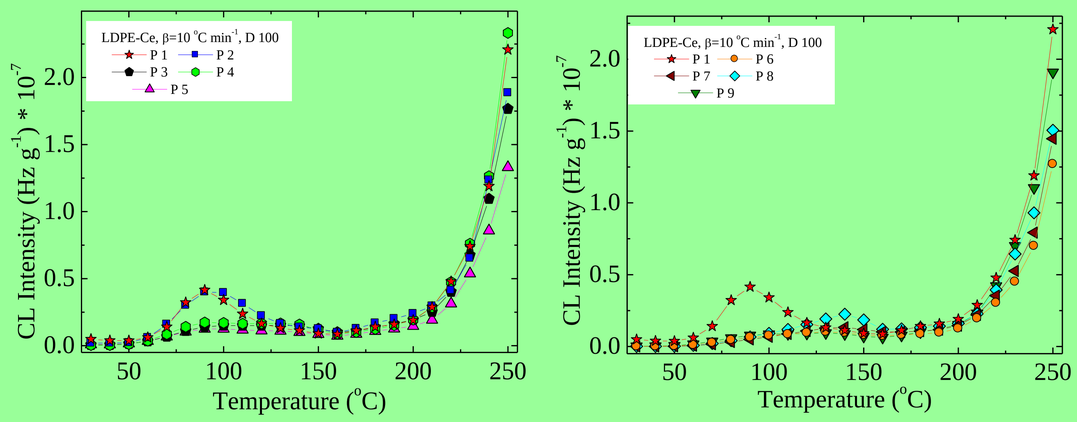

Fig. 4. Nonisothermal chemiluminescence spectra recorded on LDPE/ Ce-doped $PbZrTiO_3$ irradiated at 100 kGy

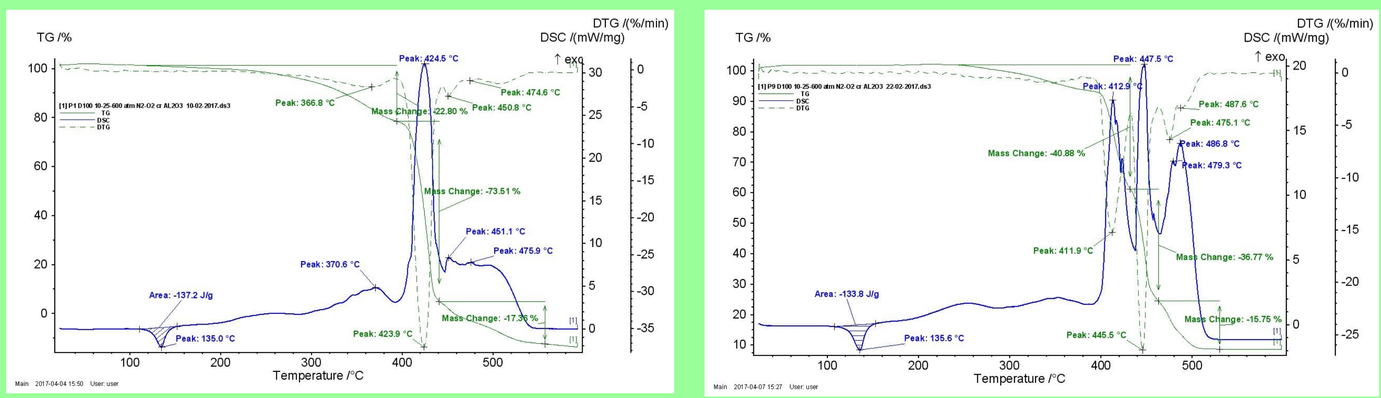

Fig. 5 Thermogravimetric diagrams of P1(left) and P9 (right) irradiated at 100 kGy

CONCLUSION

The addition of inorganic structure doped with low amounts of foreign atoms offer a certain protection of polymer substrate against oxidation. The traps work as the scavenging centres, where radical intermediates are caught. Their inactivation is more efficient at low temperatures (below 150 $_oC$), when the traps are active.

REFERENCES

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