

Luminescent ZnO/Acrylic copolymer composites, prepared by *in situ* reduction of the ZnO precursor embedded in the copolymer matrix

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Abstract – ZnO/Acrylic copolymers films were synthesized from Poly(ethylene glycol) Diacrylate (PEGDA) and triethylene glycol) Dimethacrylate (TEGDMA) using different concentrations of the zinc thenoyltrifluoroacetate ($Zn(TTA)_2$) precursor. The ZnO precursor embedded in the copolymer matrix was *in situ* reduced to ZnO nanoparticles by using hydrazine. X-Ray Diffraction results confirmed the formation of high purity ZnO nanoparticles. The high intensity emission band at 391 nm strongly suggests the formation of ZnO nanoparticles free of structural defects.

PEGDA and TEGDMA (acrylic/methacrylic) copolymers present excellent thermal and optical properties such as high degradation temperature and transparency. This copolymer has been widely applied in lens coating technology providing abrasive resistance. ZnO also presents interesting properties such as biocompatibility, UV protection and high luminescence, in addition to its low production cost^{1,2,3}. The literature presents many procedures to synthesize ZnO: by the evaporation of precursors, oxidation processes and reduction in alkaline media. However, there is no report on the synthesis of ZnO by *in situ* reduction of its precursor embedded in the copolymer matrix.

$Zn(TTA)_2$ complex was synthesized according to Malandrino et al.⁴ The $Zn(TTA)_2$ presents high solubility in the monomers used in this work. Different compositions of the complex (1 – 10% w/w) were solubilized in the monomers mixture 1:1 v/v of triethylene glycol dimethacrylate (TEGDMA) and poly(ethyleneglycol) diacrylate (PEGDA). The monomers were polymerized using the thermal initiator 2,2'-azobisisobutyronitrile (AIBN) (0.3% mol monomer) at the temperature of 70°C during 1 hour. After the polymerization, the copolymer and the $Zn(TTA)_2$ were refluxed in 0,5µL/mL of hydrazine in ethanol during 4 hours, allowing the formation of ZnO nanoparticles embedded in the copolymer matrix.

Figure 1 shows the XRD spectra of the ZnO/copolymer films with ZnO concentration of 7 and 10%. The diffraction pattern of the films confirmed the formation of high purity ZnO nanoparticles. According to the JCPDS card file³ the more pronounced crystalline planes referring to the Figure 1(d) is characteristic of the *wurtzite* structure of ZnO nanoparticles. Figure 2 displays the emission spectra of ZnO nanoparticles embedded in the copolymer matrix, with ZnO concentrations of 0.5-10.0%. The strong emission band at ca. 391 nm corroborates the XRD results, in addition it shows the presence of ZnO nanoparticles free of structural defects. The dependence of the luminescence intensity in function of the concentration of the films is related to the nanoparticles polydispersivity.

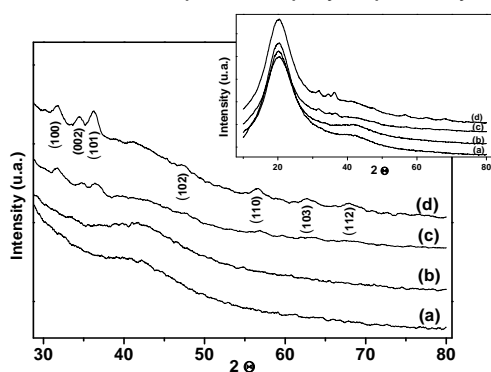


Figure 1: XRD patterns of: (a) copolymer, (b) copolymer with 5.0 % $Zn(TTA)_2$ content, (c) ZnO/copolymer film with 7.0% of ZnO and (d) ZnO/copolymer film with 10.0% of ZnO.

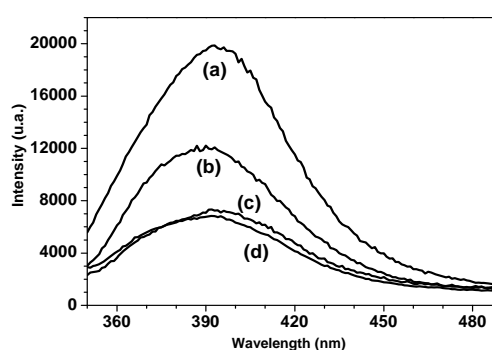


Figure 2: Room-temperature photoluminescence (PL) spectra of the nanocomposites ZnO/copolymer film, excited at 320 nm: (a) with 0.5% ZnO, (b) with 3.0% ZnO, (c) 7.0% of ZnO and (d) ZnO with 10.0% ZnO.

References

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