Natural Fe_3O_4 nanoparticles embedded zinc-tellurite glasses: Polarizability and optical properties

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Abstract	Modifying the optical behavior of zinc-tellurite glass by embedding magnetic nanoparticles has implication in nanophotonics. A series of zinc-tellurite glasses containing natural Fe3O4 nanoparticles with composition (80 - x)TeO2 center dot xFe(3)O(4)center dot 20ZnO (0 <= x <= 2) in mol% are synthesized by melt quenching method and their optical properties are investigated using FTIR and UV-vis-NIR spectroscopies. Lorentz-Lorenz relations are exploited to determine the refractive index, molar refraction and electronic polarizability. The sharp absorption peaks of FTIR spectra show a shift from 667 cm(-1) to 671 cm(-1) in the presence of nanoparticles that increase the non-bridging oxygen, confirmed by the intensity change of the TeO3 peak at 752 cm(-1). A new peak around 461 cm(-1) is also observed which is attributed to the band characteristic of covalent Fe-O linkages. A decrease in the Urbach energy as much as 0.122 eV and the optical energy band gap with the increase of Fe3O4 concentration (0.5-1.0 mol%) is evidenced. Electronic polarizability of the glasses increases with increasing Fe3O4 nanoparticles concentration up to 1 mol%. Interestingly, the polarizability tends to decrease with the further increase of Fe3O4 concentration at 2 mol%. The role of magnetic nanoparticles in influencing the structural and optical behavior are examined and understood. (C) 2012 Elsevier B.V. All rights reserved.
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