FORMATION AND OPTICAL PROPERTIES OF SILVER NANOPARTICLES IN Li₂B₄O₇–Gd₂O₃–Ag₂O BORATE GLASS

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Summary

The formation of metallic (silver) nanoparticles (AgNPs) in the near-surface layer of 97.0Li₂B₄O₇–1.0Gd₂O₃–2.0Ag₂O (Li₂B₄O₇–Gd,Ag) glass at the annealing in vacuum or in air has been reported. The “bottom-up” mechanism of nanoparticle formation is suggested. A conclusion is drawn that the annealing in vacuum does not necessarily require the presence of reducing ions, whereas the formation of nanoparticles at the annealing in air is impossible without reducing agents. Structural defects play a crucial role in the AgNPs nucleation process. The intense plasmon absorption bands peaked at 400.4, 564.2, and 413.7 nm are observed in the absorption spectra of glasses enriched with AgNPs. The average radius of nanoparticles is calculated from the half-width of plasmon bands and falls within the interval of 1.0–1.5 nm. The nonlinear refractive index $n_2$ related to plasmons in AgNPs is calculated from the normalized transmission and absorption spectra, is positive, and increases approximately 2–4 times as compared to that of Li₂B₄O₇–Gd,Ag matrix.