Refractive index and low dispersion properties of new fluorophosphate glasses highly doped with rare-earth ions

J.H. Choi and F.G. Shi
OptoElectronic Integration and Packaging Laboratory, Department of Chemical Engineering and Materials Science, University of California, Irvine, California 92697

A. Margaryan and A. Margaryan
AFO Research Inc., Glendale, California 91209

A new series of $0.4MgF_2$-$0.4BaF_2$-$0.1Ba(PO_3)_2$-$0.1Al(PO_3)_3$ glasses highly doped with rare-earth dopants (RE; Nd_2O_3, Er_2O_3, and Yb_2O_3) have been successfully developed for laser applications. Linear refractive index, dispersion properties including Abbe number (v), dispersion parameter (*A*', *B*'), electronic osciallator energy (E_o), and electronic osciallator strength (E_d) were determined as a function of RE dopants. The refractive index (n_D=1.5872 to 1.6047) was found to linearly increase with dopant concentrations irrespective of types of rare earth dopants, while the Abbe number (v = 65.7 to 68.8) and dispersion parameters including *A*' (~62), *B*', E_o (13 ± 0.5 eV), and E_d (19 ± 1 eV) exhibit a concentration independence. It is remarkable that the refractive index of those new glasses increased with increasing RE dopant concentration, while the relatively large Abbe number of those glasses was independent of dopant concentration. The dependence of refractive index (*n*) on RE cations with high polarizabilities are discussed in terms of molar volume (V_m) and molar refractivity (R_m). Electronic oscillator strengths (E_d), the average electronic energy gap (E_o), and their respective dependence on RE dopant concentration were also investigated using linear refractive index (*n*) and Abbe number (v). Those results suggest the present new series of glasses are strong candidates for stable laser hosts with extremely low dispersion.