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Photoluminescent and optical properties of ZnSe crystals doped with Gd impurity are investigated in infrared (IR) spectral range. The influence of crystal growth temperature, impurity concentration, stoichiometric deviation and post-annealing cooling rate, concentration of Cr and Cu background impurities, temperature and excitation level on photoluminescent and optical properties of the samples is studied. Based on these investigations, the structure of complex IR photoluminescence (PL) bands is analyzed. Correlation between the component parts of the bands at 1 and 2 μm is found and possibility to control the IR PL spectra by enrichment of the samples with Zn or Se is discussed. Coincidence of the IR PL spectra structure is shown for the samples doped with Gd, Yb, and Cr impurities. The model that explains the formation of complexes based on rare-earth elements (REEs) and Cr and Cu background impurities fixed in the nodes of crystal lattice with tetrahedral symmetry, responsible for IR PL bands, is proposed.