Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information

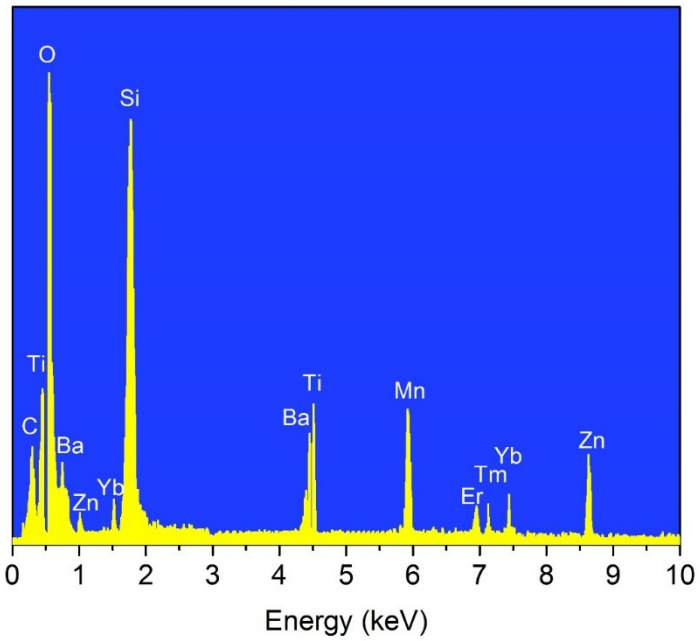

Fig. S1 EDS spectrum analysis of SZB-0.5Er1Tm2Yb2Mn glass sample.

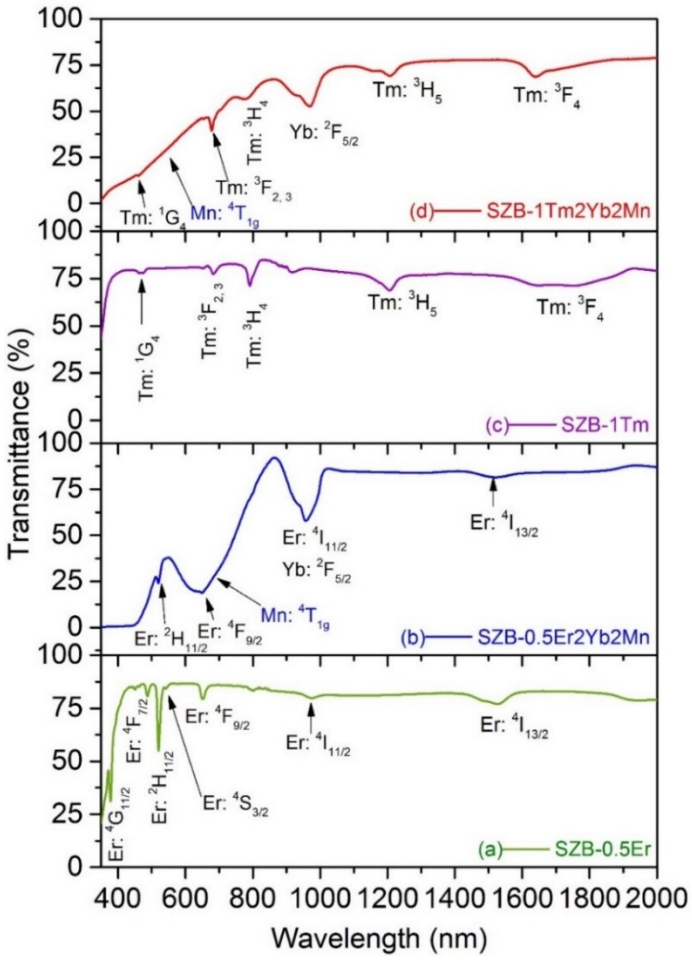

Fig. S2(A) Optical transmittance spectra of SZB-0.5Er, SZB-0.5Er2Yb2Mn, SZB-1Tm, and SZB-1Tm2Yb2Mn glass samples.

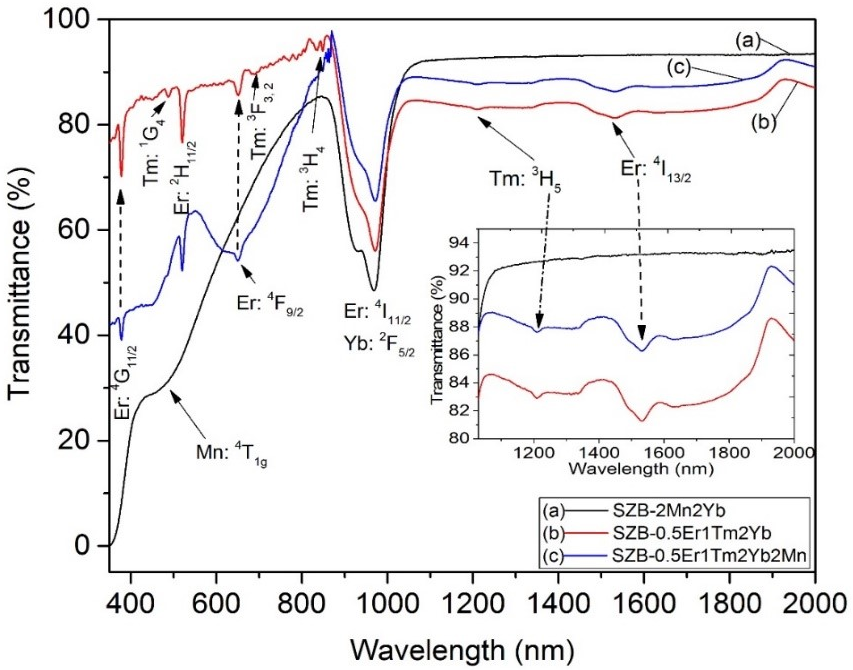

Fig. S2(B) Optical transmittance spectra of SZB-2Mn2Yb, SZB-0.5Er1Tm2Yb, and SZB-0.5Er1Tm2Yb2Mn glass samples.

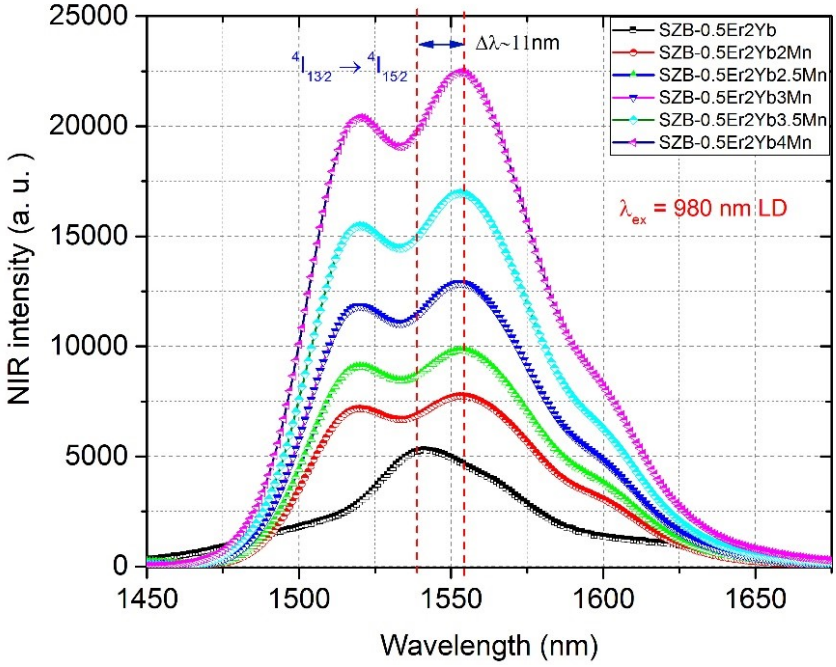

Fig. S3 NIR emission spectra of SZB-0.5Er2YbxMn (x = 0, 2, 2.5, 3, 3.5, and 4 mol. %) glass samples.

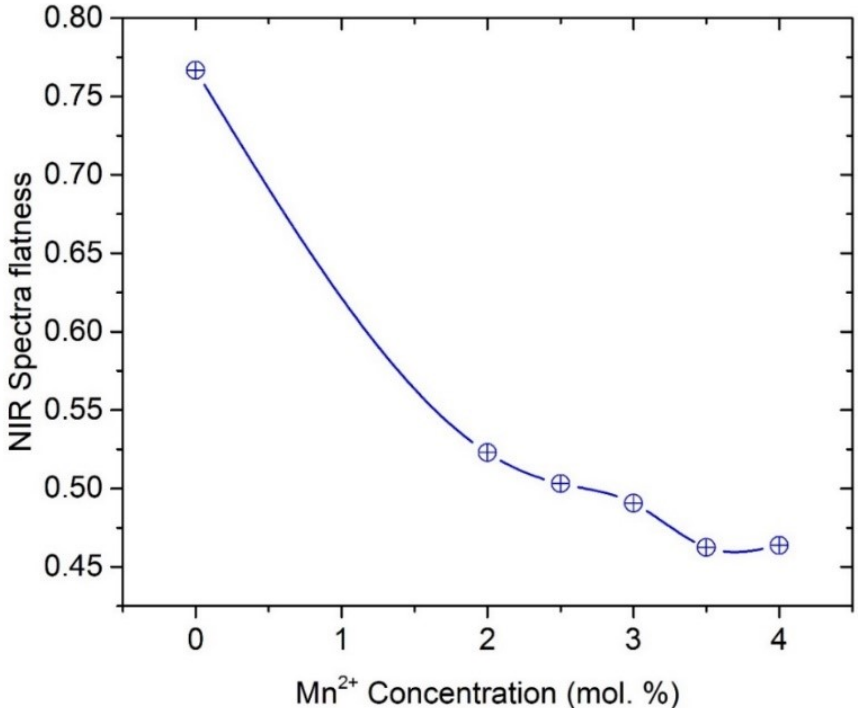

Fig. S4 Relationship between NIR spectra flatness of SZB-0.5Er2YbxMn (x = 0, 2, 2.5, 3, 3.5, and 4 mol. %) glass samples and molar concentration of Mn^{2+} ions.

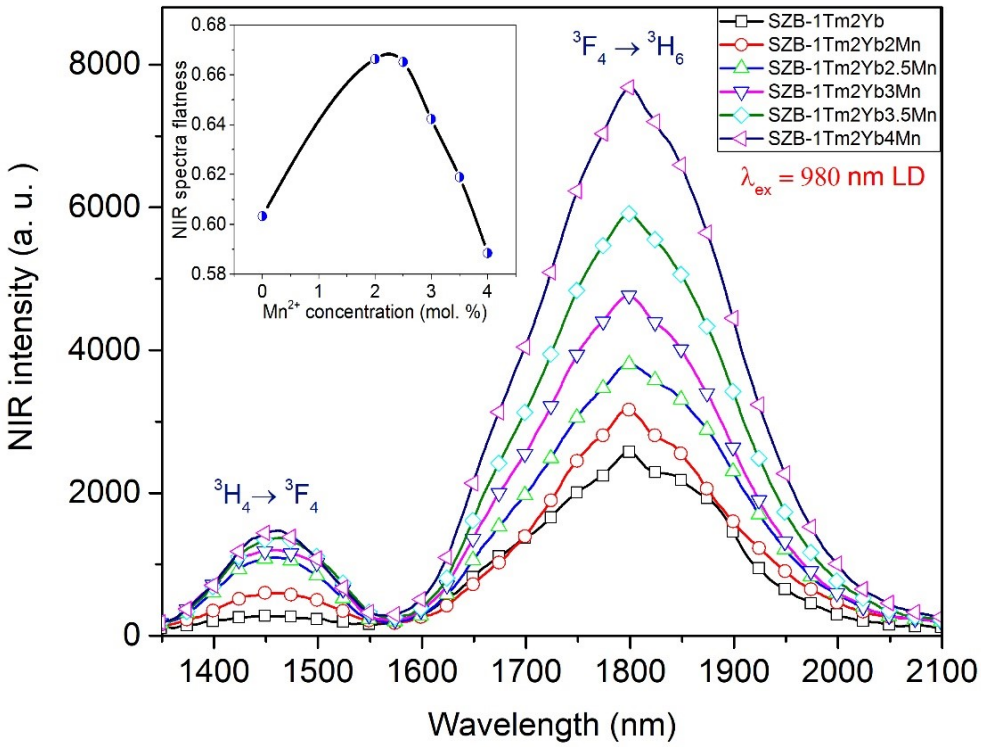

Fig. S5 NIR emission spectra of SZB-1Tm2YbxMn (x = 0, 2, 2.5, 3, 3.5, and 4 mol. %) glass samples.

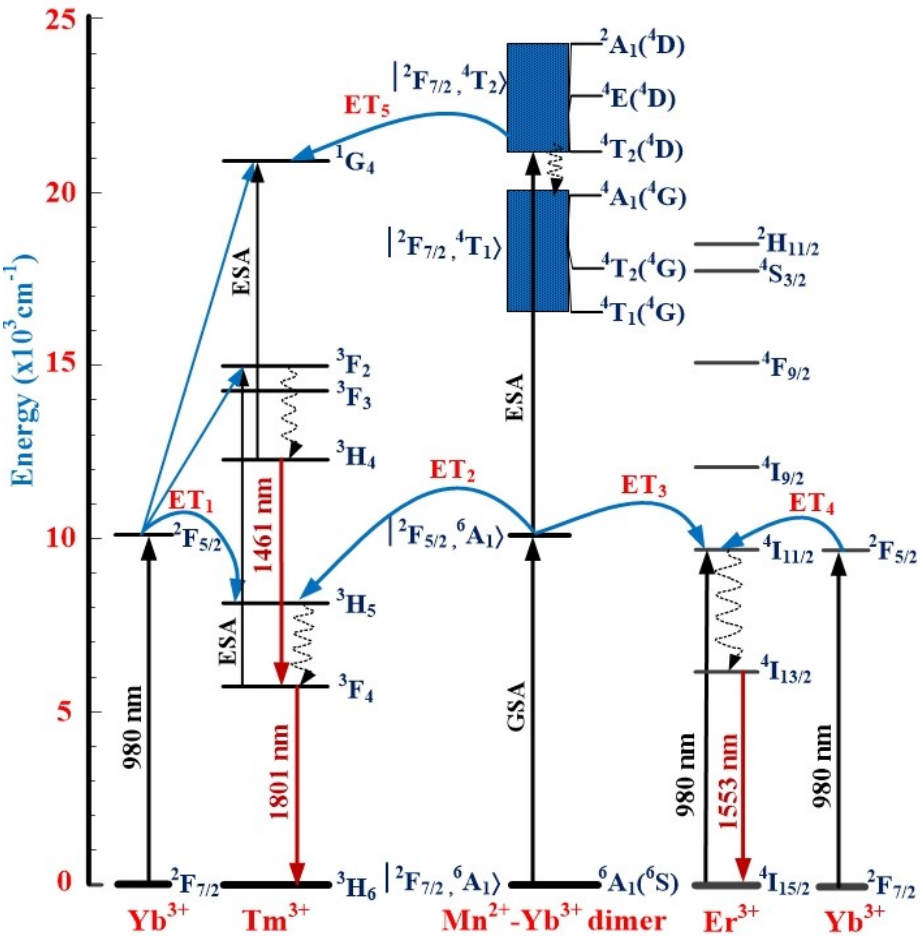

Fig. S6 Energy levels of Er^{3+}, Tm^{3+}, Yb^{3+}, Mn^{2+}–Yb^{3+} dimer and mechanisms of ET_I (I = 1, 2, 3, 4, and 5) processes in SZB glass system.

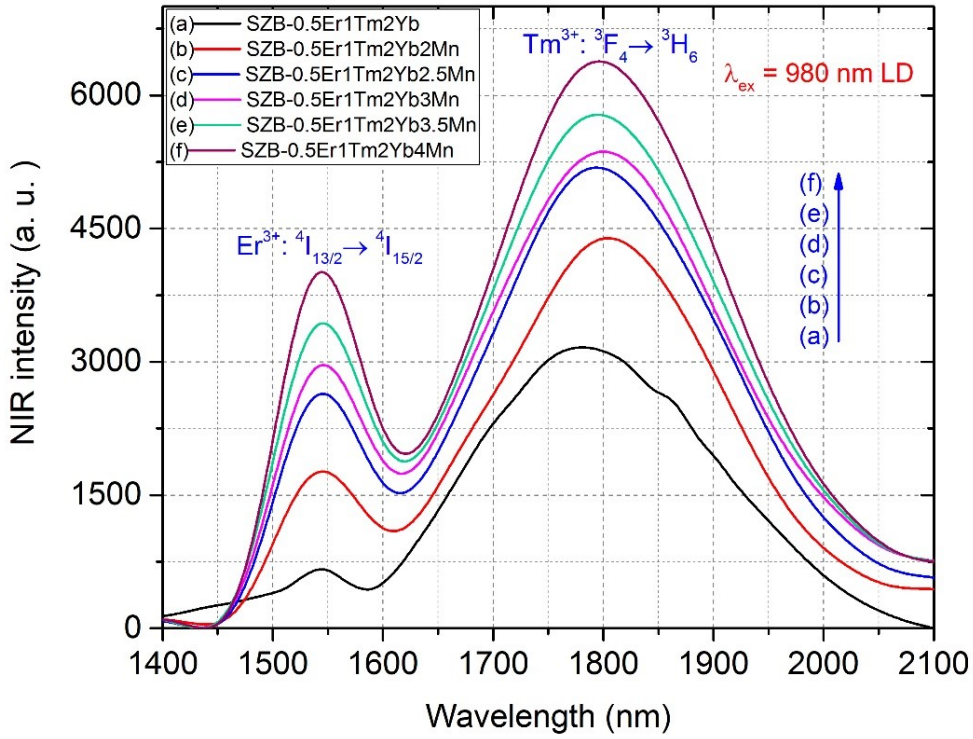

Fig. S7 NIR emission spectra of SZB-0.5Er1Tm2YbxMn (x = 0, 2, 2.5, 3, 3.5, and 4 mol. %) glass samples.

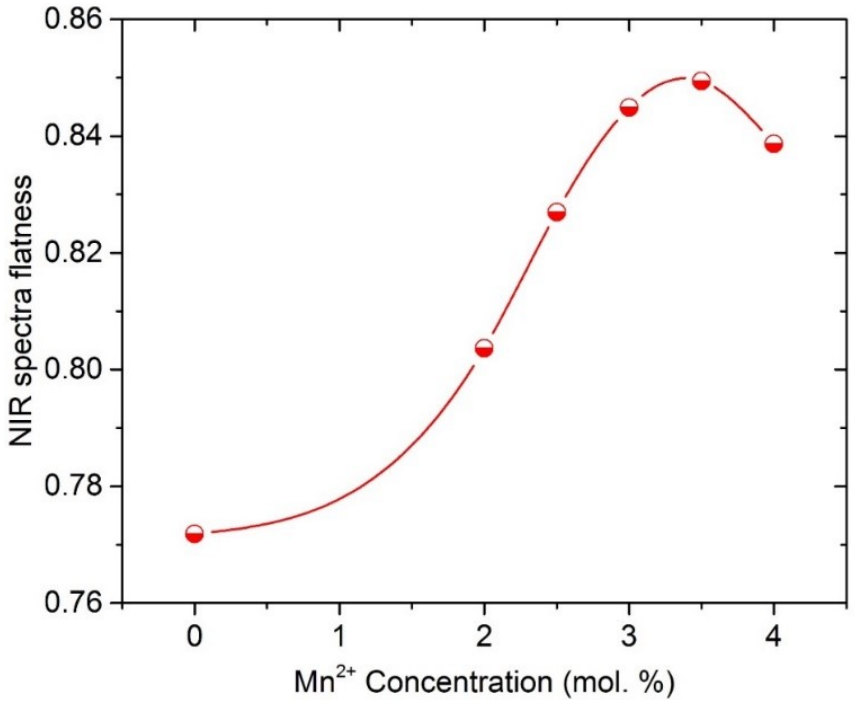

Fig. S8 The relationship between the molar concentration of Mn^{2+} ions and NIR_EBF parameter of SZB-0.5Er1Tm2YbxMn (x = 0, 2, 2.5, 3, 3.5, and 4 mol. %) glass samples.

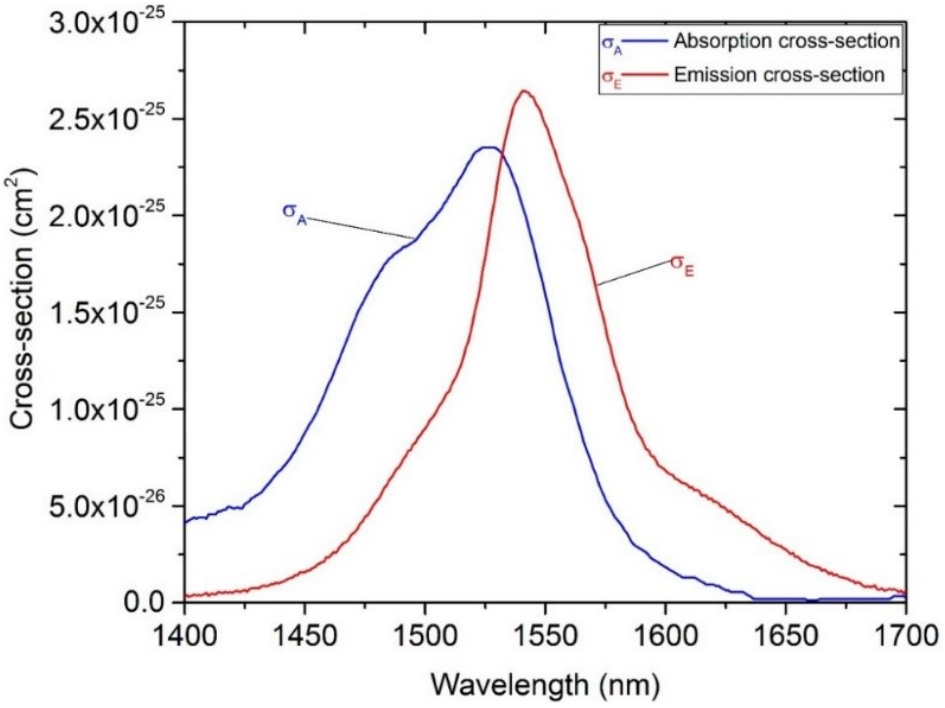

Fig. S9 Absorption and emission cross-sections of SZB-0.5Er glass sample.

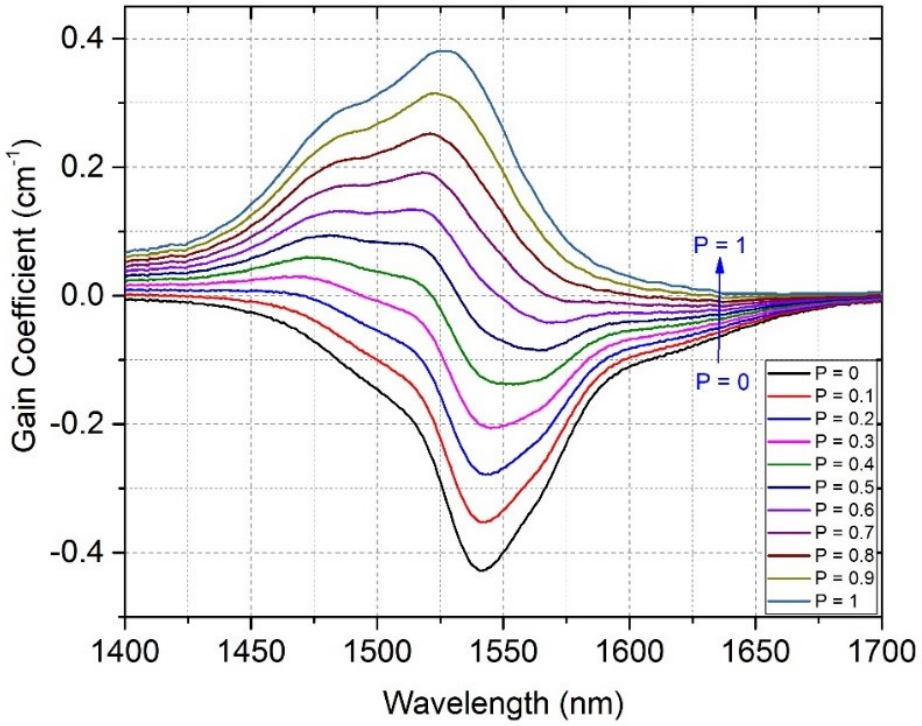

Fig. S10 Gain coefficient for the $^4I_{13/2} \rightarrow {}^4I_{15/2}$ transition of Er^{3+} ions in SZB-0.5Er glass sample

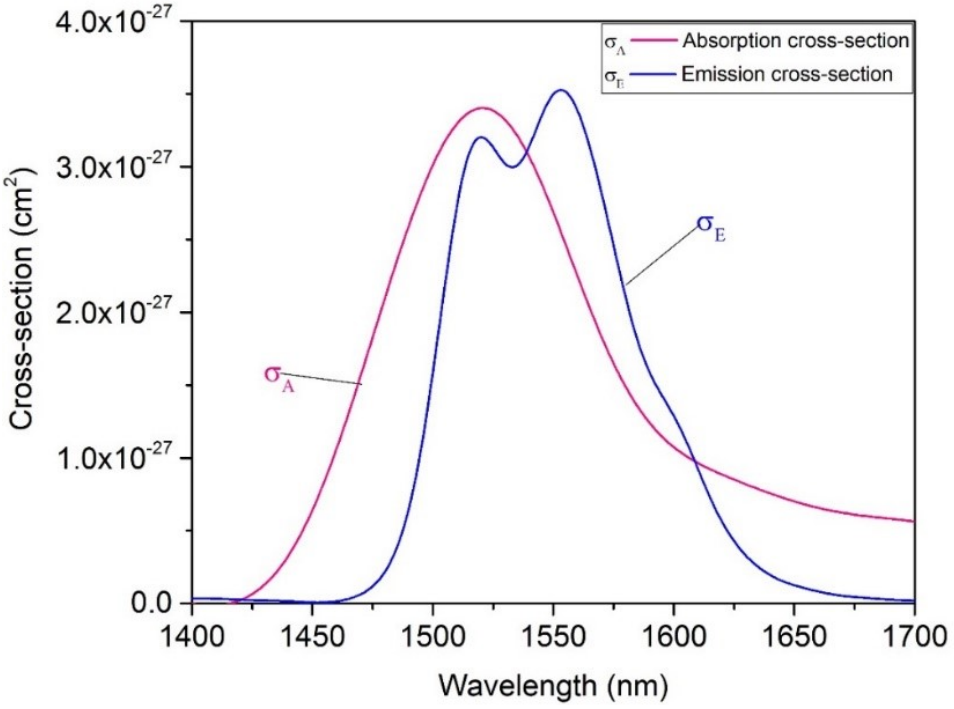

Fig. S11 Absorption and emission cross-sections of SZB-0.5Er2Yb2Mn glass sample.

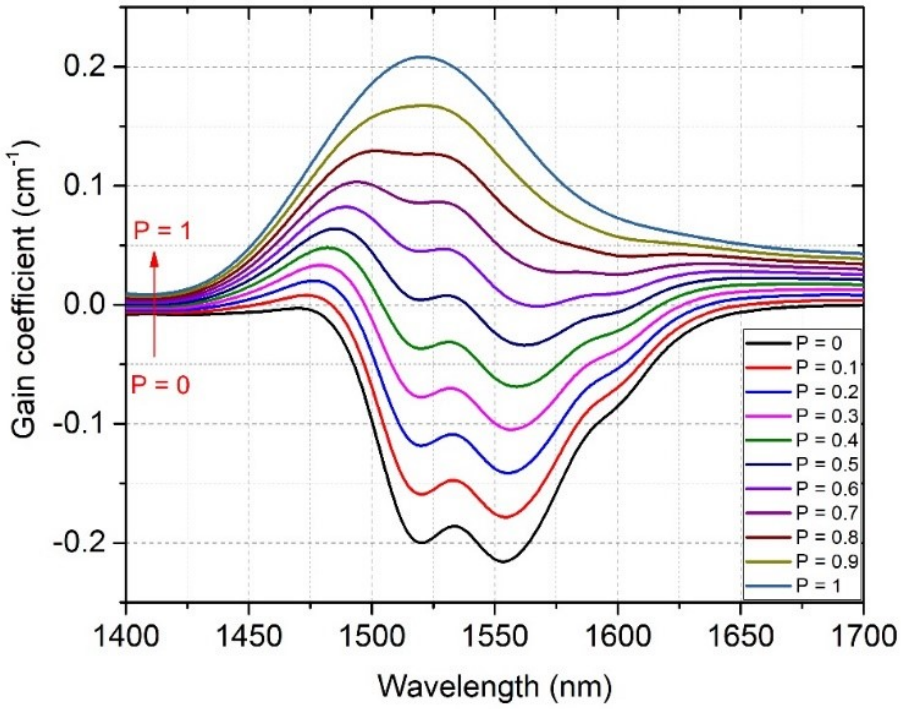

Fig. S12 Gain coefficient for the $^4I_{13/2} \rightarrow {}^4I_{15/2}$ transition of Er^{3+} ions in SZB-0.5Er2Yb2Mn glass sample