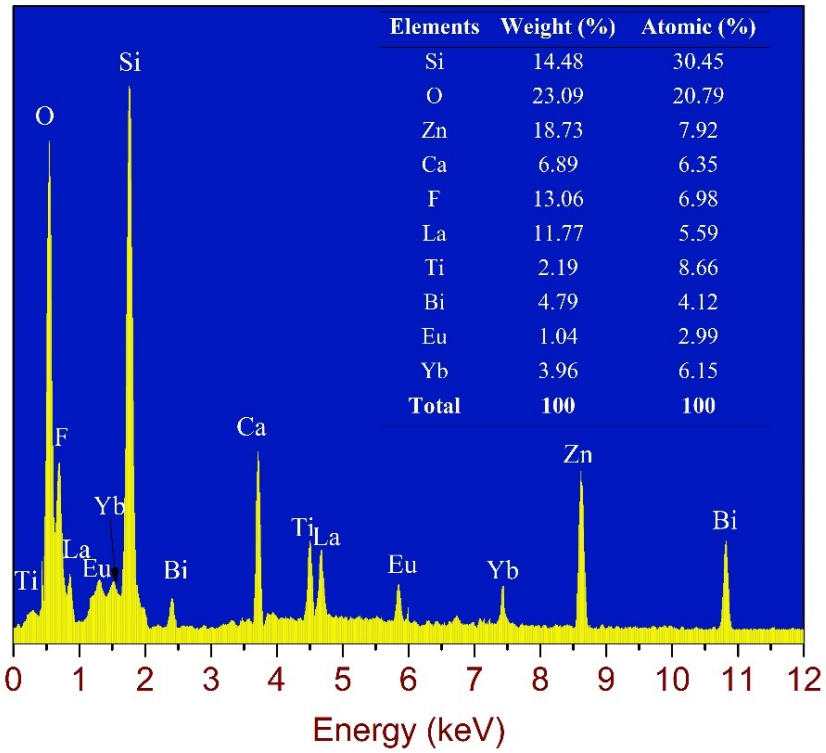
Electronic Supplementary Information



Elements	Weight (%)	Atomic (%)
Si	14.48	30.45
O	23.09	20.79
Zn	18.73	7.92
Ca	6.89	6.35
F	13.06	6.98
La	11.77	5.59
Ti	2.19	8.66
Bi	4.79	4.12
Eu	1.04	2.99
Yb	3.96	6.15
Total	**100**	**100**

Fig. S1 EDS spectrum of SZC-1.0Bi0.6Eu2Yb zinc calcium silicate glass sample.

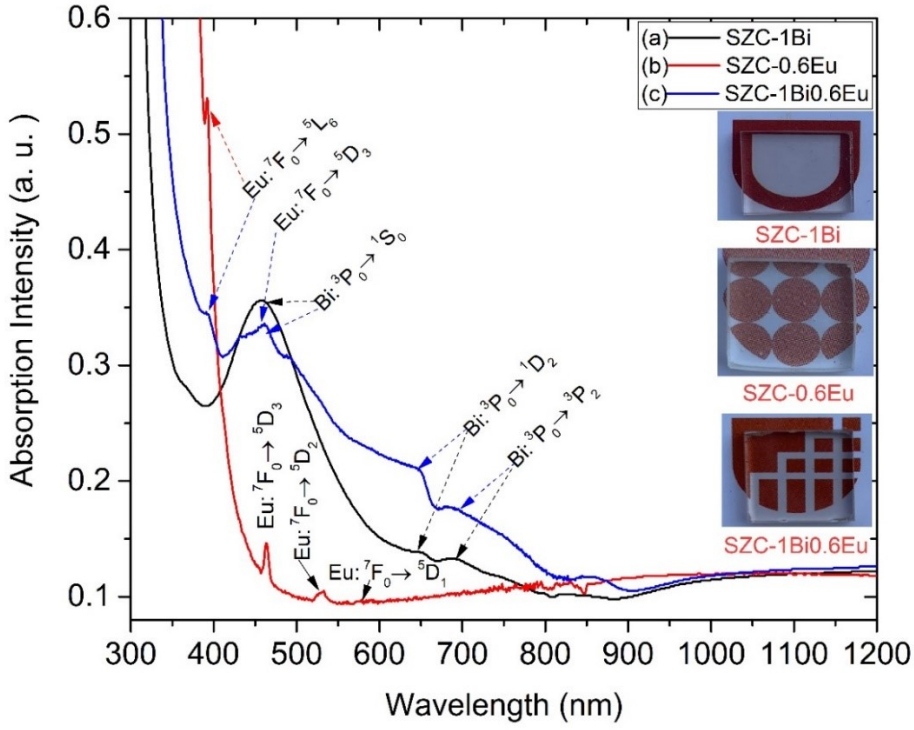


Fig. S2 Absorption spectra of SZC-1.0Bi, SZC-0.6Eu, and SZC-1.0Bi0.6Eu zinc calcium silicate glass samples.

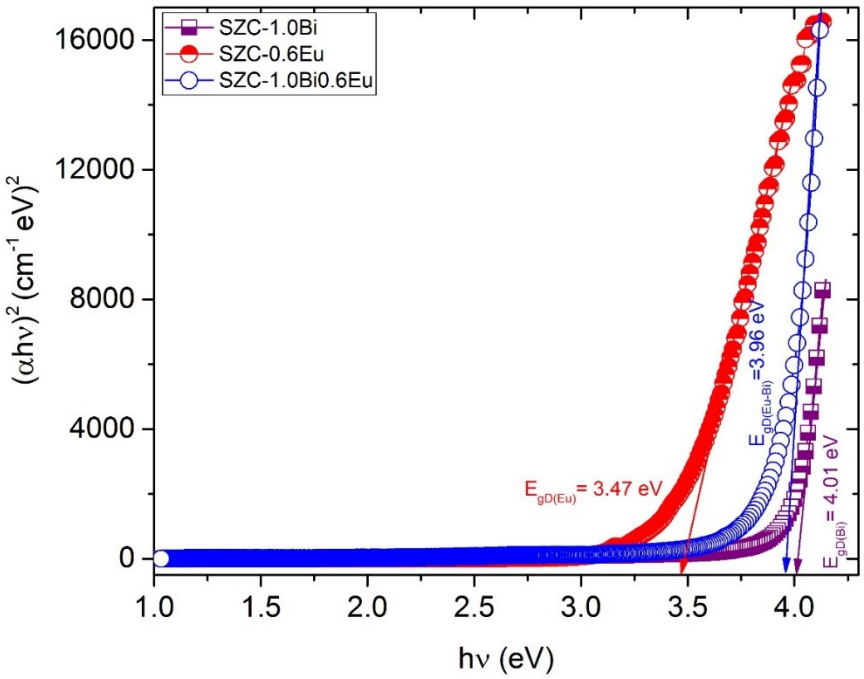


Fig. S3 (a) Direct optical band gaps of SZC-1.0Bi, SZC-0.6Eu, and SZC-1.0Bi0.6Eu zinc calcium silicate glass samples.

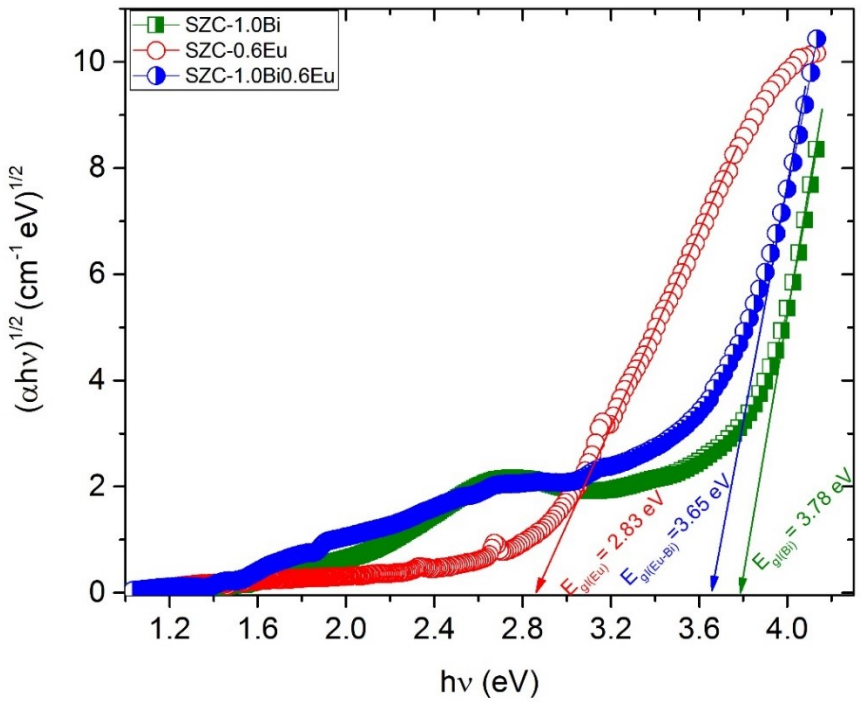


Fig. S3 (b) Indirect optical band gaps of SZC-1.0Bi, SZC-0.6Eu, and SZC-1.0Bi0.6Eu zinc calcium silicate glass samples.

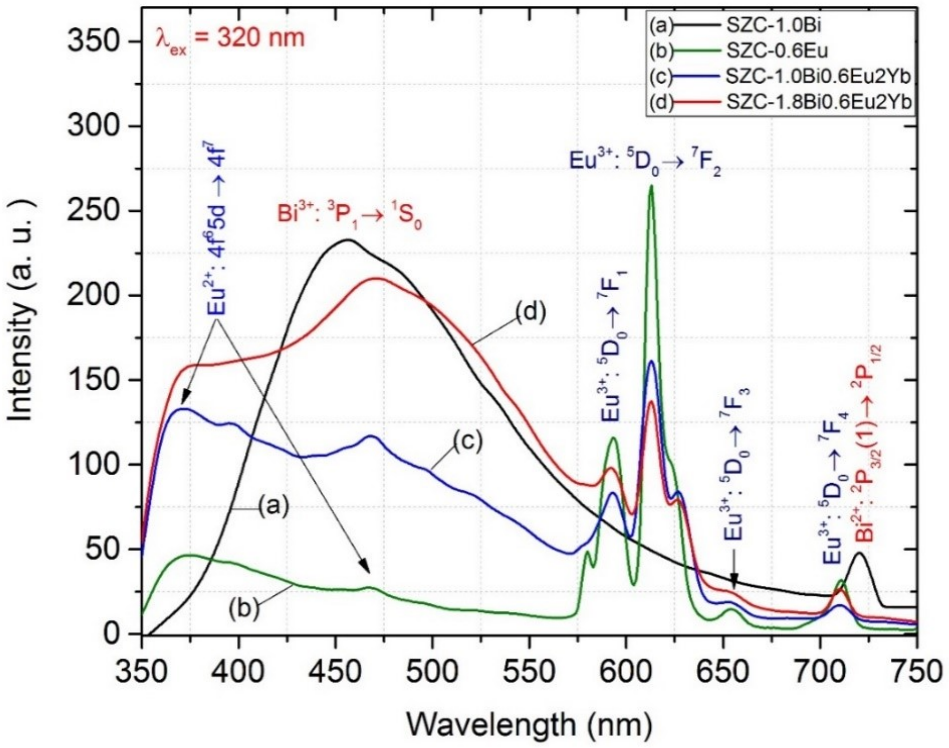


Fig. S4 VIS emission spectra of SZC-1.0Bi, SZC-0.6Eu, SACL-1.0Bi0.6Eu2Yb and SACL-1.8Bi0.6Eu2Yb zinc calcium silicate glass samples under 320 nm excitation.

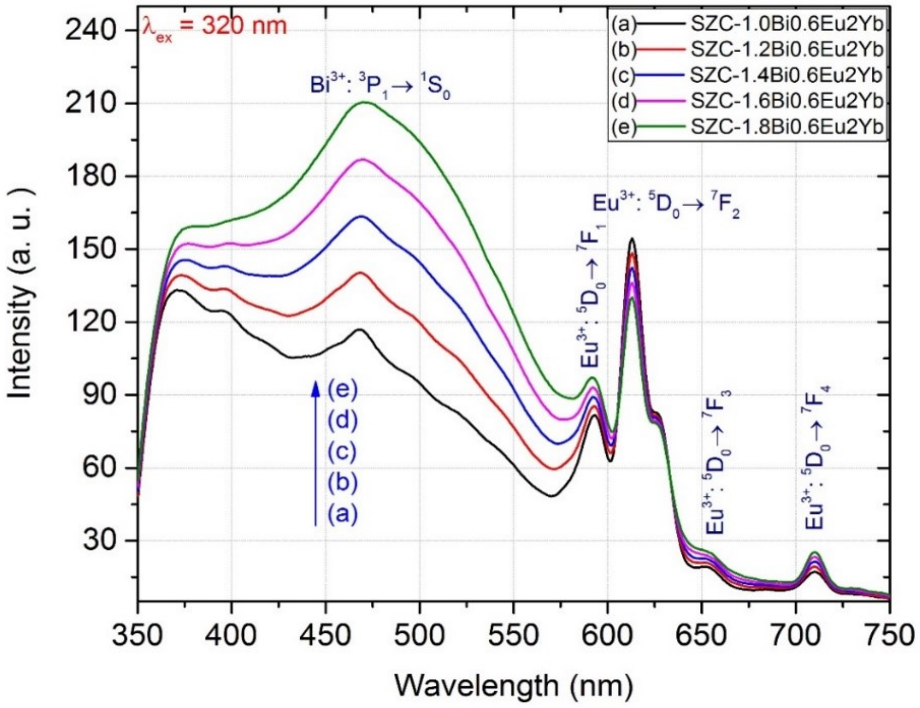


Fig. S5 VIS emission spectra of SZC-xBi0.6Eu2Yb (x = 1.0, 1.2, 1.4, 1.6, and 1.8 mol. %) zinc calcium silicate glass samples under 320 nm excitation.

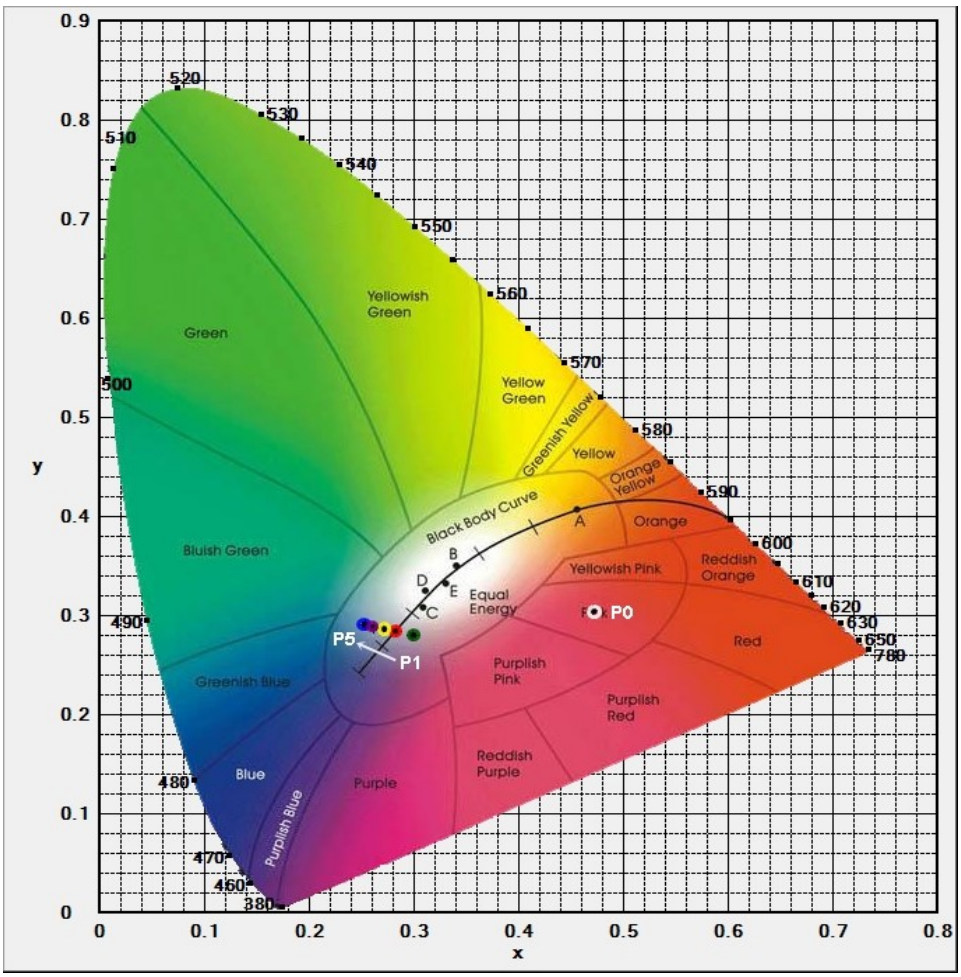


Fig. S6 CIE 1931 (x, y) color coordinates for VIS emission of SZC-0.6Eu and SZC-xBi0.6Eu2Yb (x = 1.0, 1.2, 1.4, 1.6, and 1.8 mol. %) zinc calcium silicate glass samples under 320 nm excitation.

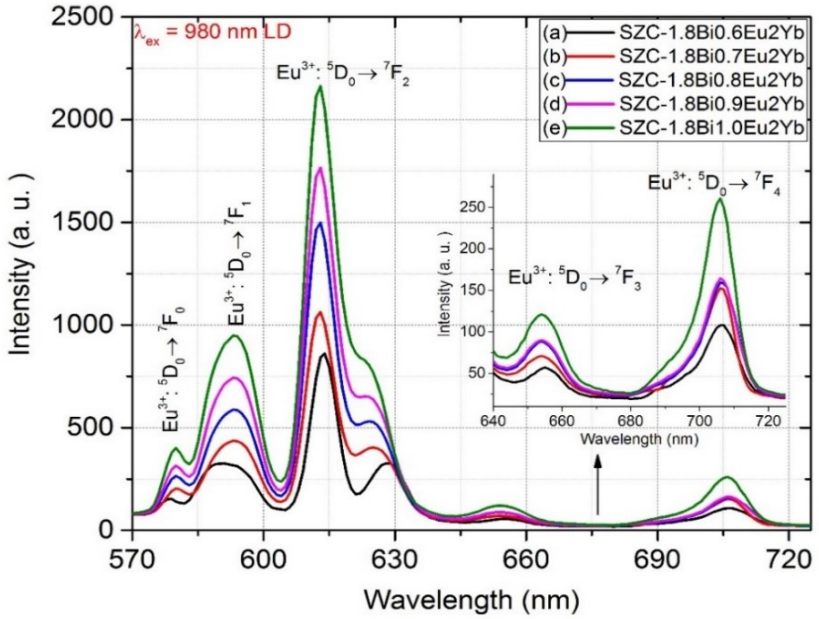


Fig. S7 UC emission spectra of SZC-1.8BiyEu2Yb (y = 0.6, 0.7, 0.8, 0.9, and 1.0 mol. %) zinc calcium silicate glass samples.

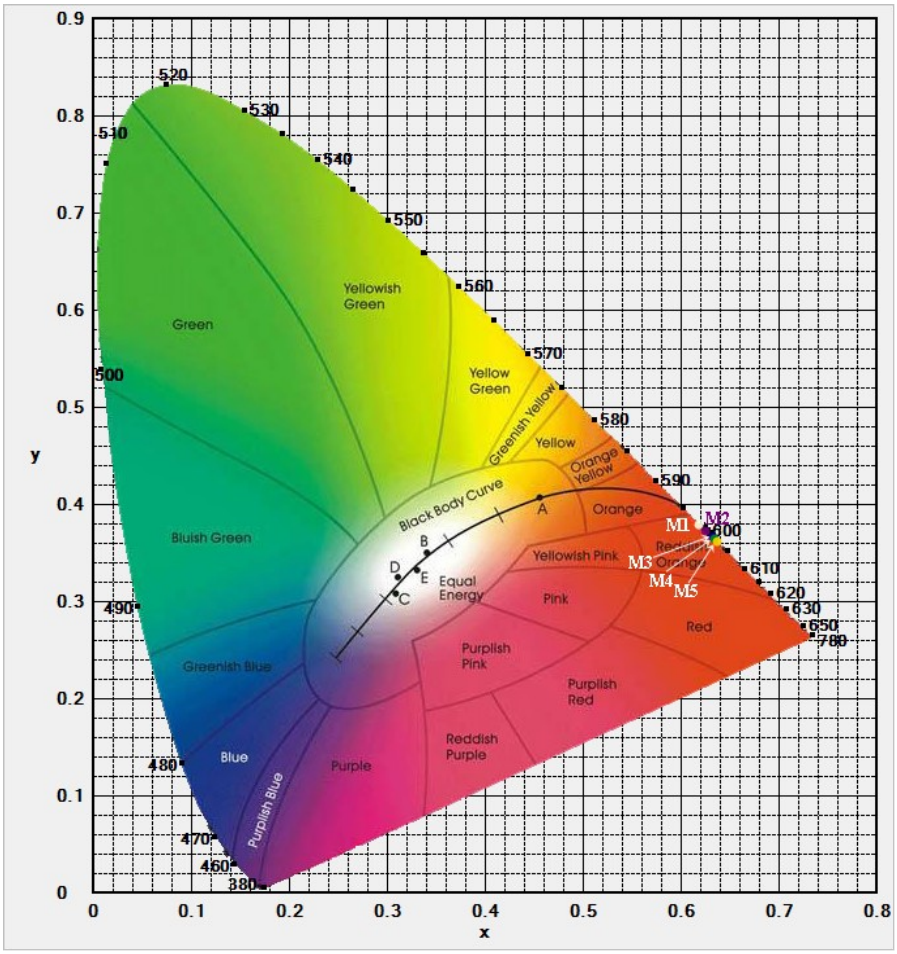


Fig. S8 CIE 1931 (x, y) for UC emission spectra of SZC-1.8BiyEu2Yb (y = 0.6, 0.7, 0.8, 0.9, and 1.0 mol. %) zinc calcium silicate glass samples under 980 nm LD excitation.

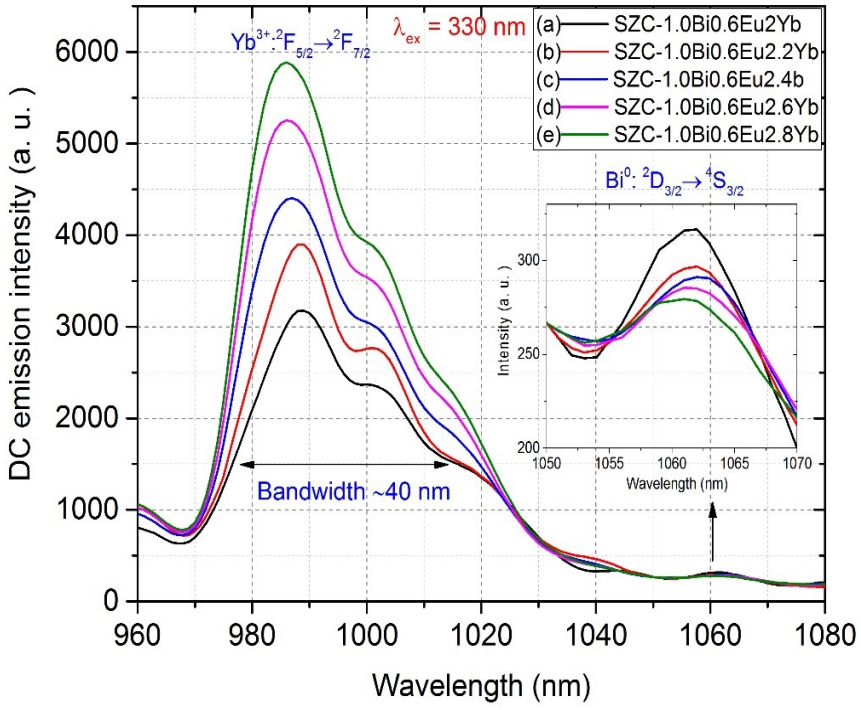


Fig. S9 NIR emission spectra of SZC-1Bi0.6EuzYb (z = 2.0, 2.2, 2.4, 2.6, and 2.8 mol. %) zinc calcium silicate glass samples.

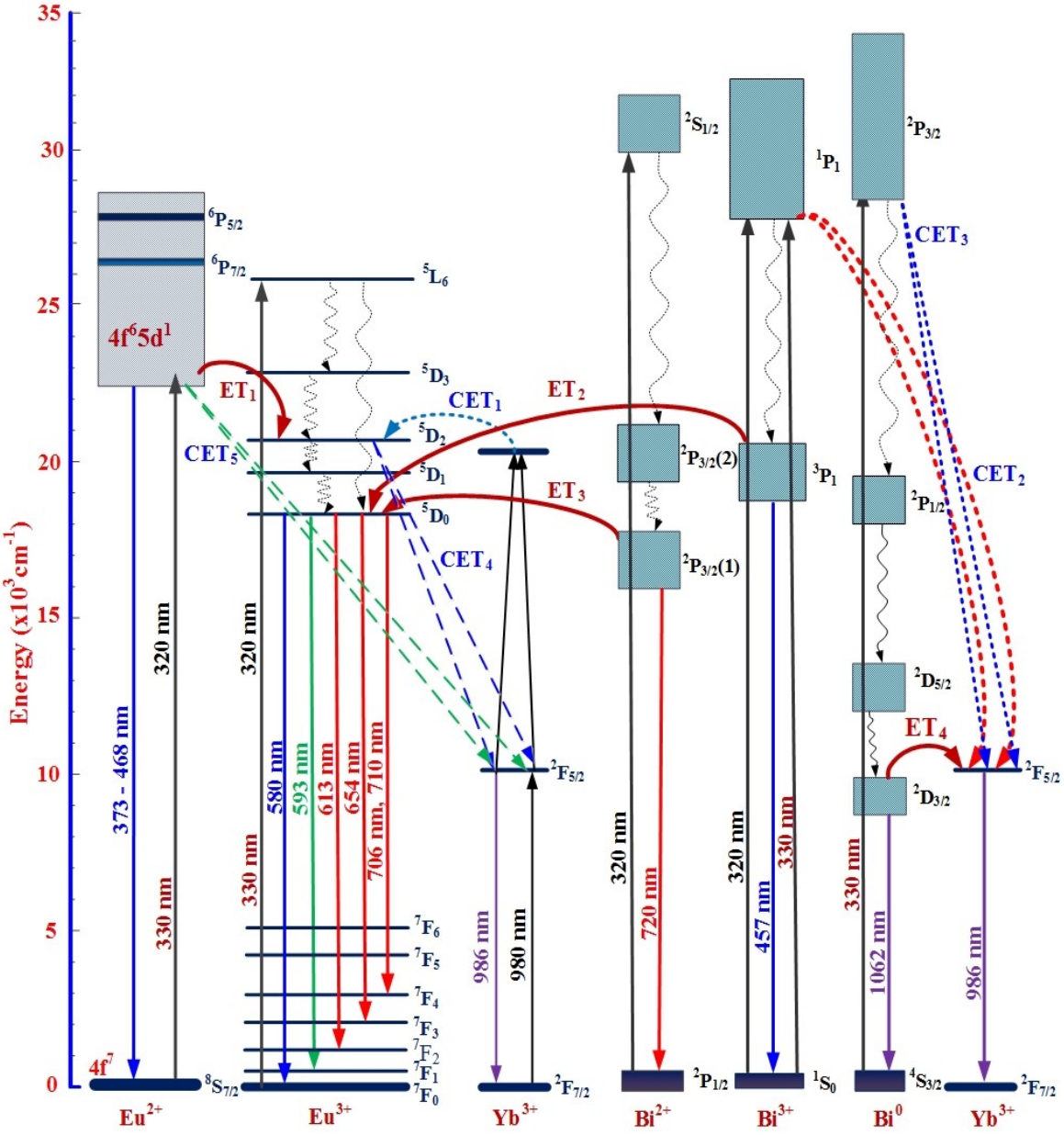


Fig. S10 Energy levels, VIS-, UC-, NIR- emissions and mechanism of $CET_{I(I\ from\ 1\ to\ 5)}$, and $ET_{J\ (J\ from\ 1\ to\ 4)}$ processes between Bi^{m+}, Eu^{n+}, and Yb^{3+} in SZC zinc calcium silicate glasses.