Highly efficient, tunable, ultrabroadband NIR photoemission from Bi-doped nitridated germanate glasses toward all-band amplification in optical communication

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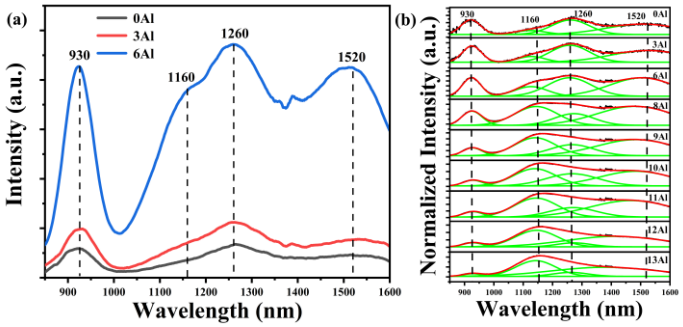

Fig. S1. (a) NIR PL spectra (λ_{ex} = 460 nm) of Bi-doped nitridated germanate glasses with 0Al, 3Al, and 6Al. (b) Comparison between the NIR PL spectra of sample containing xAl_2O_3 (x = 0–13%) by Gaussian fitting.

What is more remarkable is that the relative intensity of band at ~1160 nm is weaker than that of ~ 930, ~1260, ~1520 nm at low content of Al_2O_3, as shown in Fig. S1 (a). Nevertheless, the abnormal phenomenon is observed with further increasing the content of Al_2O_3, which indicates that the addition of Al_2O_3 is beneficial for ~1160 nm (Bi^+) emission. To learn more details on the NIR PL spectra, the Gauss fitting of the emission spectra of all the samples shown in Fig. S1 (b) provides a more intuitive change for the phenomenon discussed above. The emission bands at ~930, ~1260, ~1520 nm dominate at 0~6Al samples, however, the emission at ~1160 nm gradually replaces other bands and becomes the main emission band, which indicates that the introduction of Al_2O_3 can effectively manipulate the multiple Bi NIR centers. Apart from this, the variation of the emission peak shapes may give effective clues on the origin of the emission bands at ~930 and ~1520 nm. As the Al_2O_3 content increases, the shape and relative intensities of the bands at ~930 and ~1520 nm show a similar trend with that of ~1260 nm, which further implies that the root of ~930 and ~1520 nm maybe closely related to ~1260 nm (Bi^0), but not only to Bi.

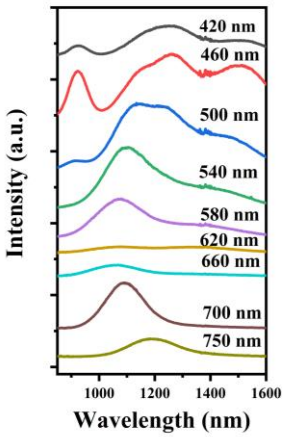

Fig. S2. The NIR spectra evolution of the 6Al glass sample.

Due to the co-existence of multiple NIR centers in Bi-doped nitridated germanate glass, the luminescence behaviour could be adjusted flexibly and effectively by tuning excitation wavelength to fully cover the NIR region from 850 to 1700 nm, as presented in Fig. S2, and the performance of emission bandwidth and tunability in the glass surpassed the previous study involving Bi or Bi-RE co-doped glass.

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