Electronic Supplementary Material (ESI) for Nanoscale.

Broad-band nonlinear optical response in $Bi_2Te_{0.6}S_{2.4}$ alloys based on the Alloying-engineered

Haixia Zhu[1], Zhaozhe Chen[1], Rui Dai[1], Bojun Yang[1], Mianzeng Zhong[1], Si Xiao[1], Jun He[1]

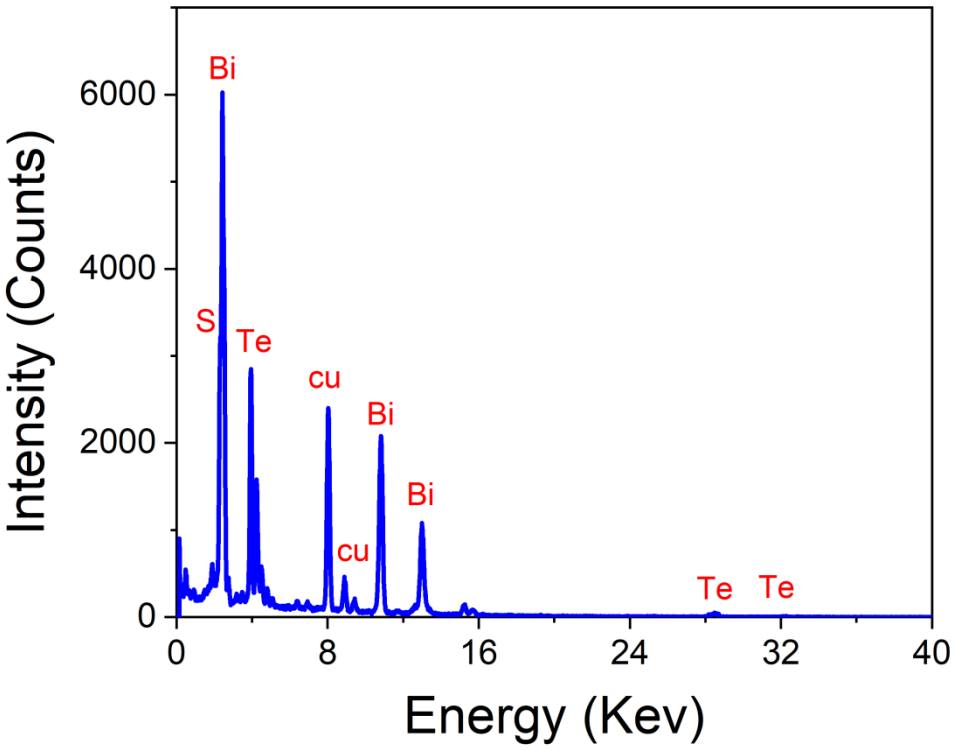

Figure S1. Energy-dispersive X-ray spectroscopy (EDS) spectrum of $Bi_2(Te_xSe_{1-x})_3$ crystals.

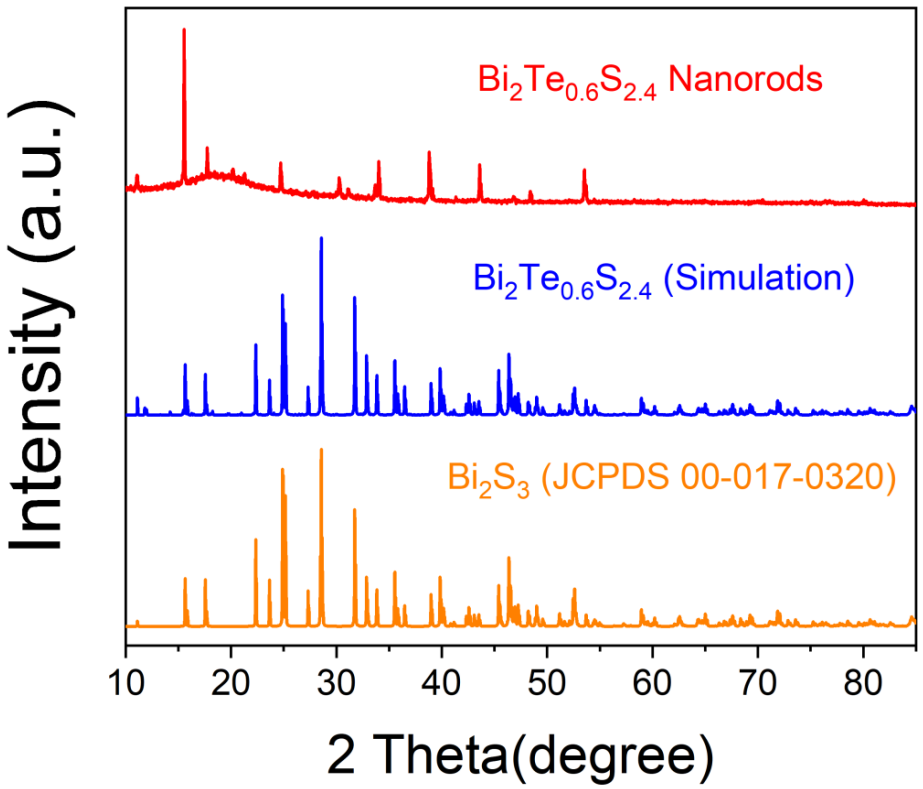

Figure S2. XRD pattern of $Bi_2Te_{0.6}S_{2.4}$ nanorods (top), simulation $Bi_2Te_{0.6}S_{2.4}$ powder (middle), and JCPDS 00-017-0320 (Bi_2S_3) (bottom).

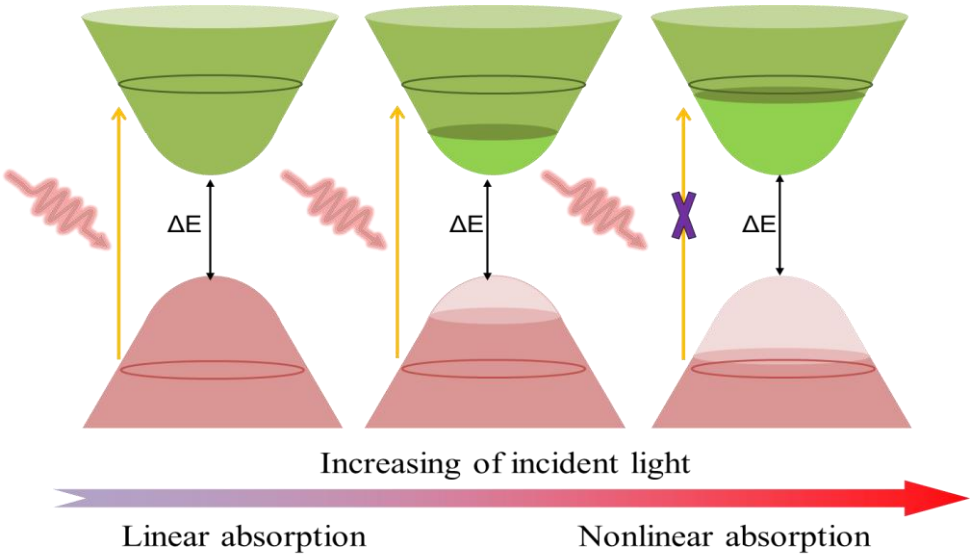

Figure S3 Schematic diagram of saturable absorption due to pauli blocking principle.

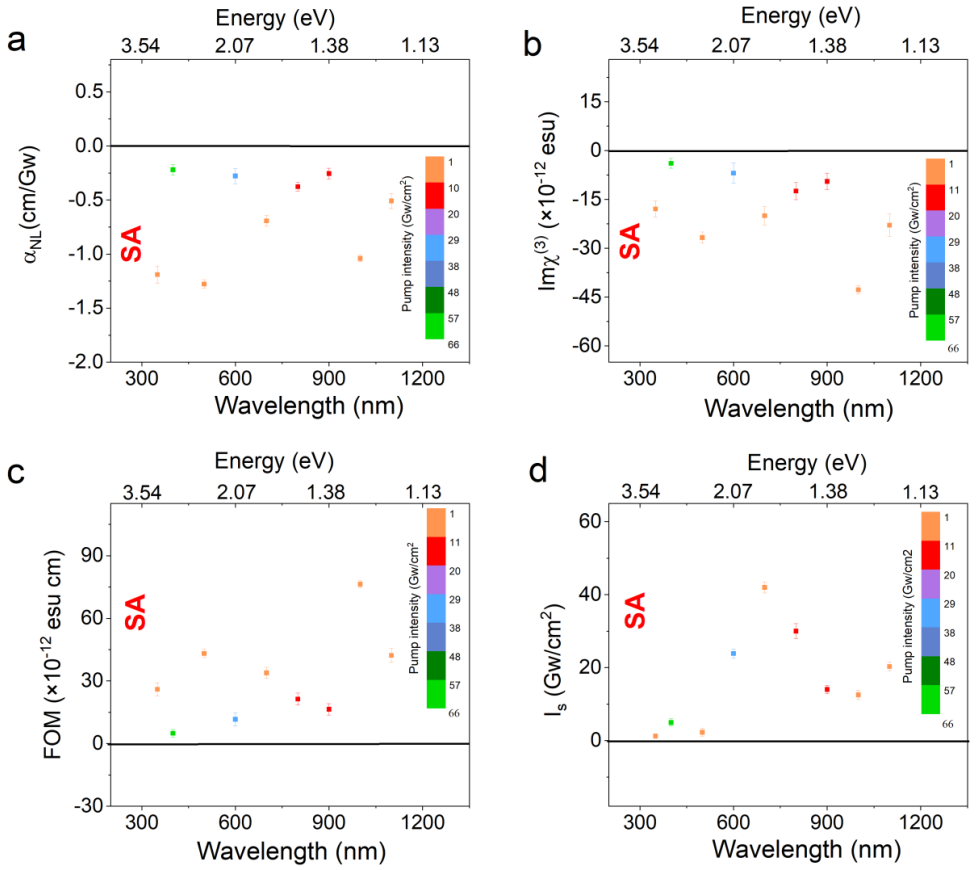

Figure S4 Wavelength dependence of (a) nonlinear absorption coefficient (b) the imaginary part of the third-order nonlinear optical susceptibility (c) the figure of merit (d) saturable absorption intensity.

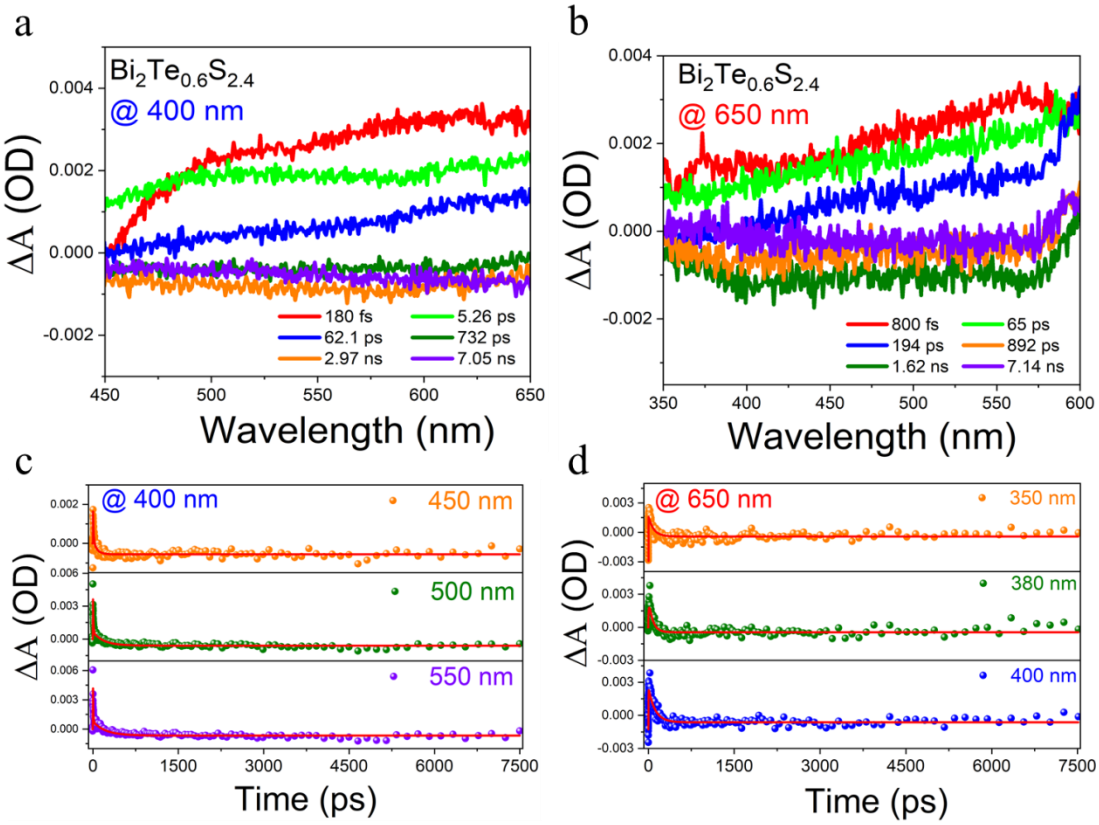

Figure S5 *f*s transient absorption spectra of $Bi_2Te_{0.6}S_{2.4}$ nanorods pumped at 400 nm (a) and 650 nm (b). Dynamic curves and fitted results of $Bi_2Te_{0.6}S_{2.4}$ nanorods pumped at 400 nm (c) and 650 nm (d).

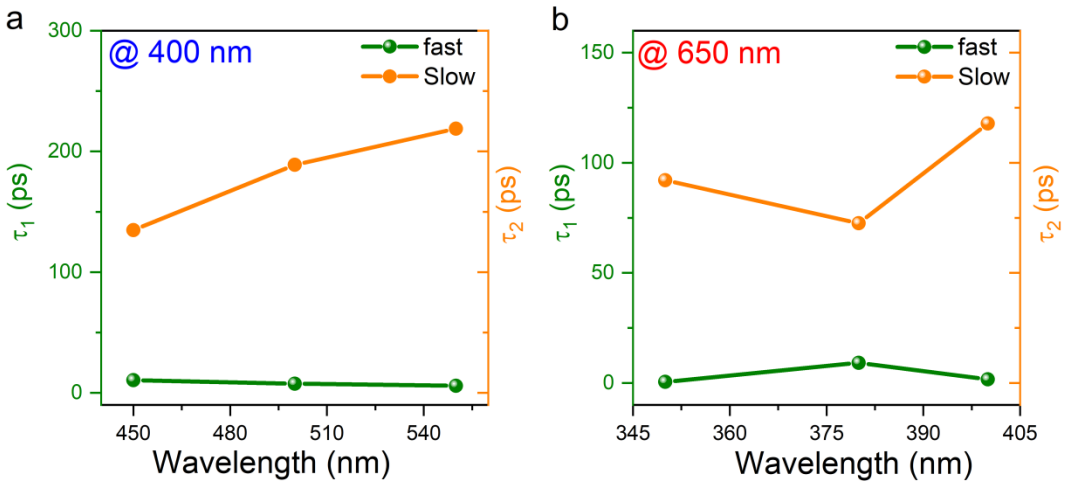

Figure S6 Fitting results of two ultrafast relaxation times pumped at 400 nm (a) and 650 nm (b), respectively.