Supporting Information

Optimizing the performance of wide-bandgap CZTS solar cells: Influence of heterojunction structures, buffer thickness and doping concentrations

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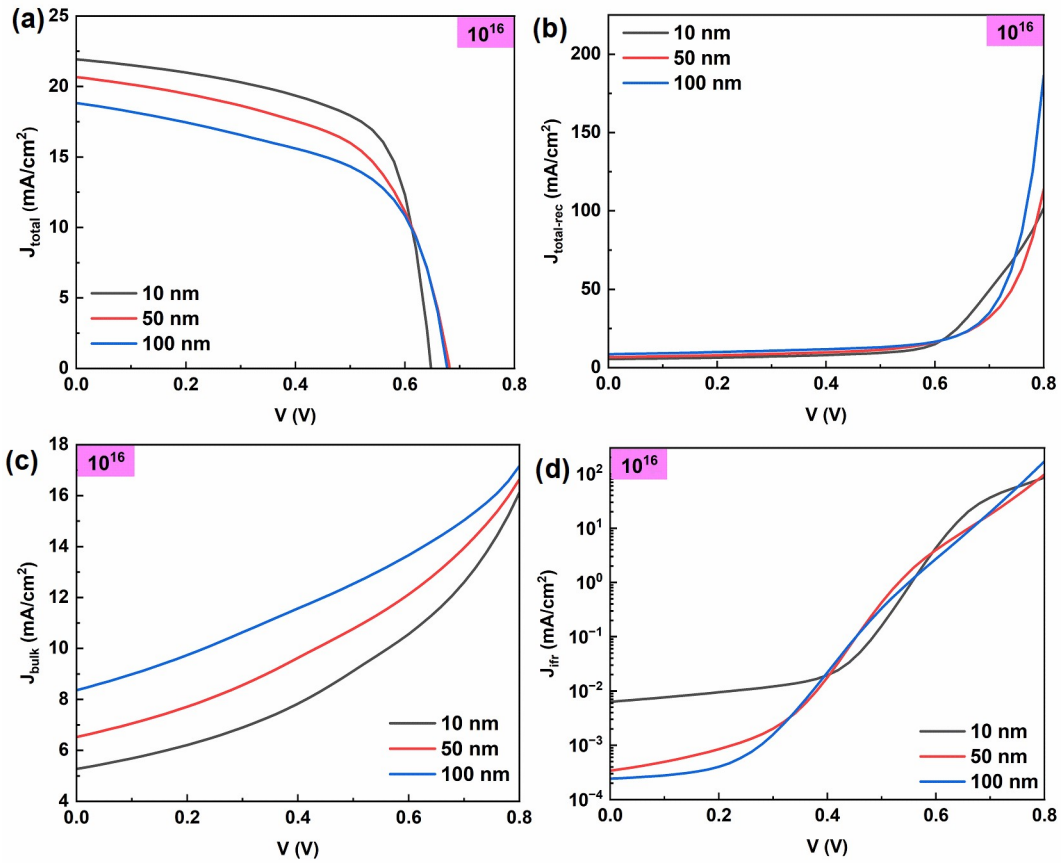

Fig. S1 (a) The J-V curves of CZTS solar cells with the CdS layer (doping concentration of 10^{16} cm^{-3}) thickness of 10 nm, 50 nm, and 100 nm. (b-d) The $J_{total\text{-}rec}$-V, J_{bulk}-V, and J_{ifr}-V curves of these CZTS solar cells.

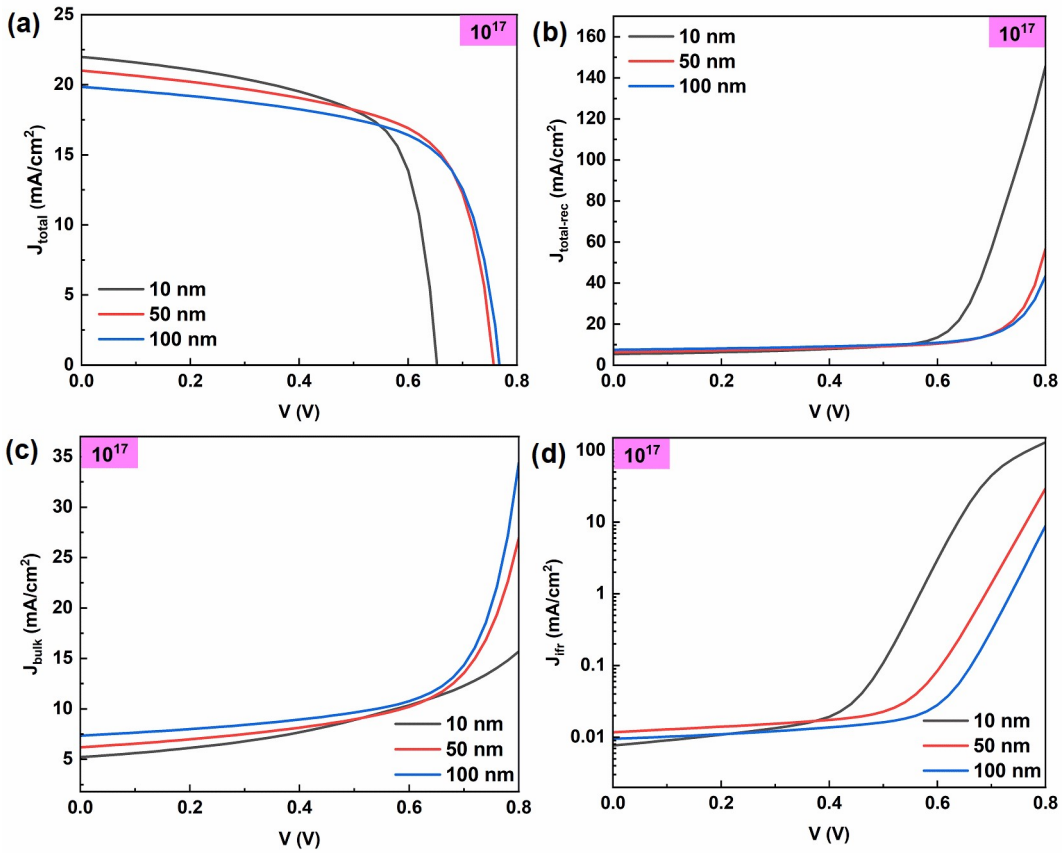

Fig. S2 (a) The J-V curves of CZTS solar cells with the CdS layer (doping concentration of 10^{17} cm^{-3}) thickness of 10 nm, 50 nm, and 100 nm. (b-d) The $J_{total\text{-}rec}$-V, J_{bulk}-V, and J_{ifr}-V curves of these CZTS solar cells.

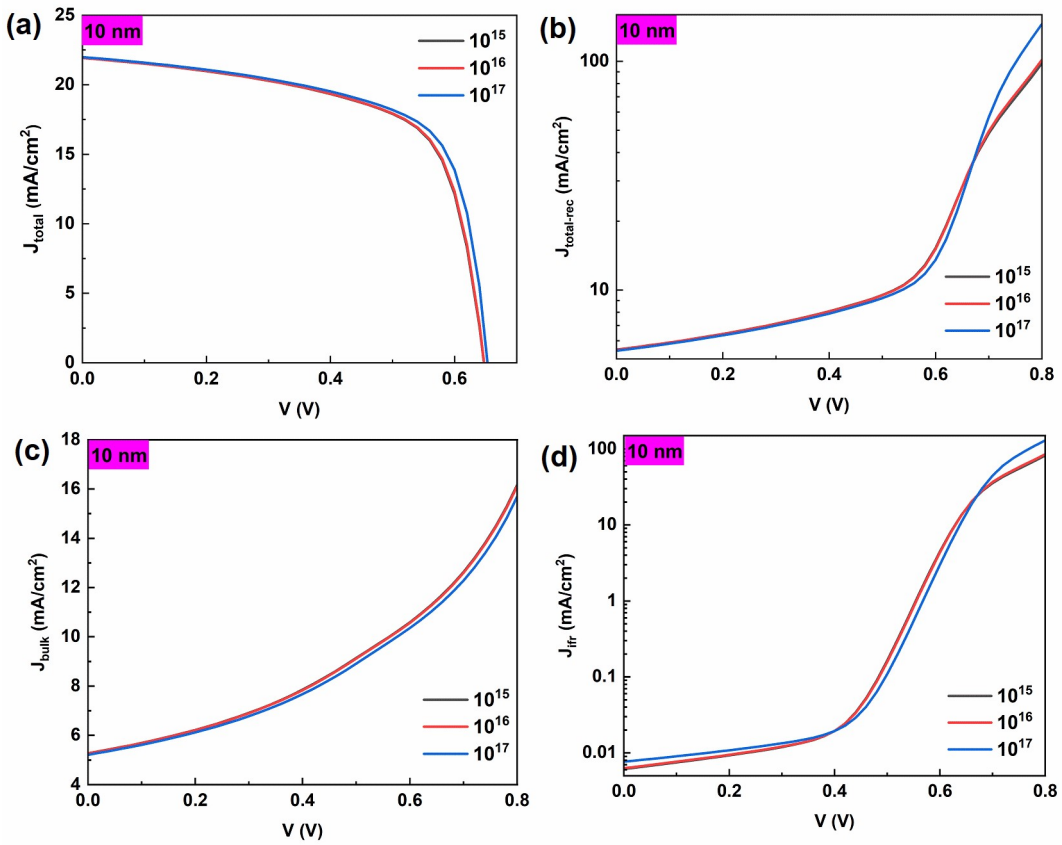

Fig. S3 (a) The J-V curves of CZTS solar cells with the CdS layer (thickness of 10 nm) doping concentration of 10^{15} cm^{-3}, 10^{16} cm^{-3}, and 10^{17} cm^{-3}. (b-d) The $J_{total-rec}$-V, J_{bulk}-V, and J_{ifr}-V curves of these CZTS solar cells.

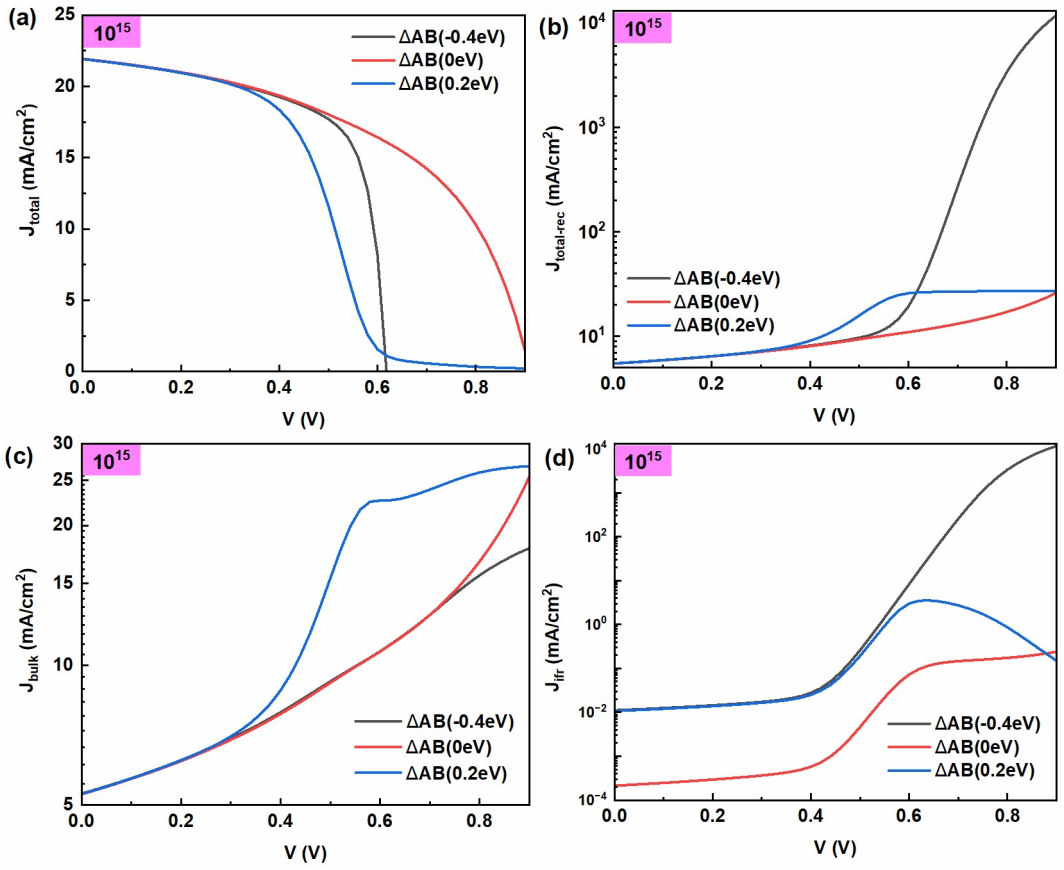

Fig. S4 (a) The J-V curves of CZTS solar cells with the different CBO (−0.4 eV, 0 eV, and 0.2 eV) and the CdS layer doping concentration of 10^{15} cm^{-3}. (b-d) The $J_{total-rec}$-V, J_{bulk}-V, and J_{ifr}-V curves of these CZTS solar cells.

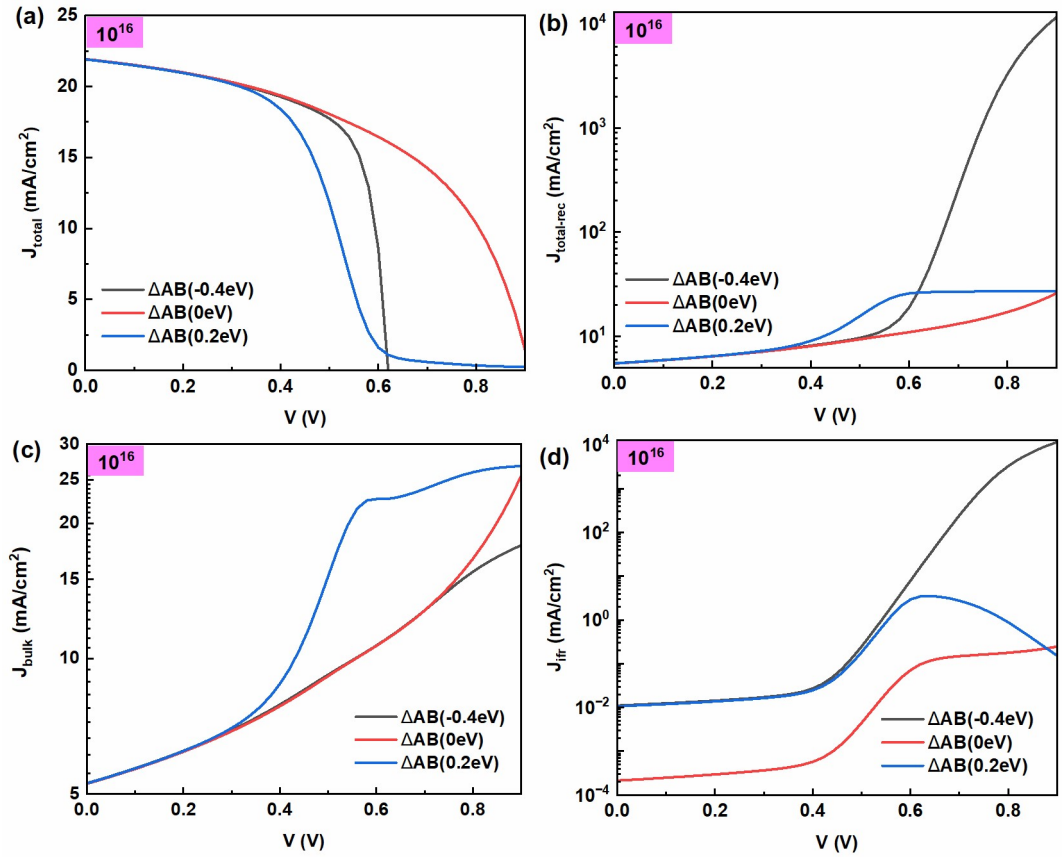

Fig. S5 (a) The J-V curves of CZTS solar cells with the different CBO (−0.4 eV, 0 eV, and 0.2 eV) and the CdS layer doping concentration of 10^{16} cm^{-3}. (b-d) The $J_{total-rec}$-V, J_{bulk}-V, and J_{ifr}-V curves of these CZTS solar cells.

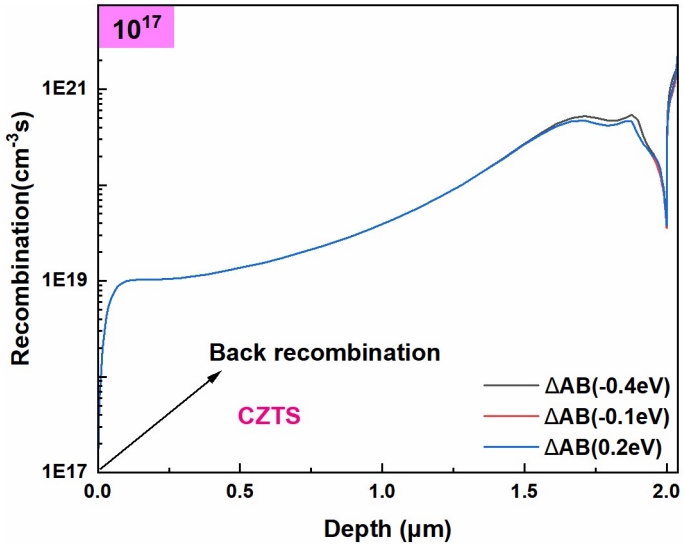

Fig. S6 The recombination rate of CZTS solar cells with the different CBO (−0.4 eV, −0.1 eV, and 0.2 eV) and the CdS layer doping concentration of 10^{17} cm^{-3}.