

Electronic Supporting Information

Elucidating the Energy and Electron Transfer Dynamics of Photon Upconversion in Self-Assembled Bilayers

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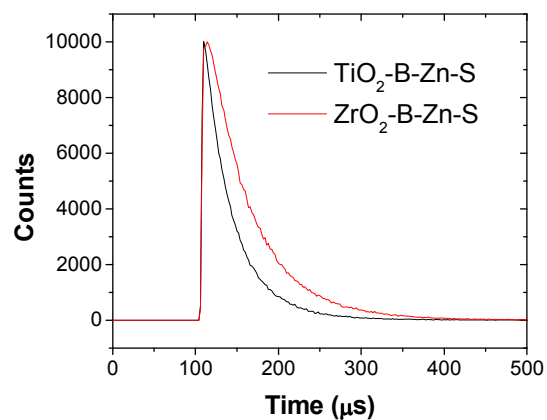


Figure S1. Time resolved emission spectra of TiO₂-B-Zn-S (black) and ZrO₂-B-Zn-S (red) excited at 532 nm and monitoring S emission at 670 nm.

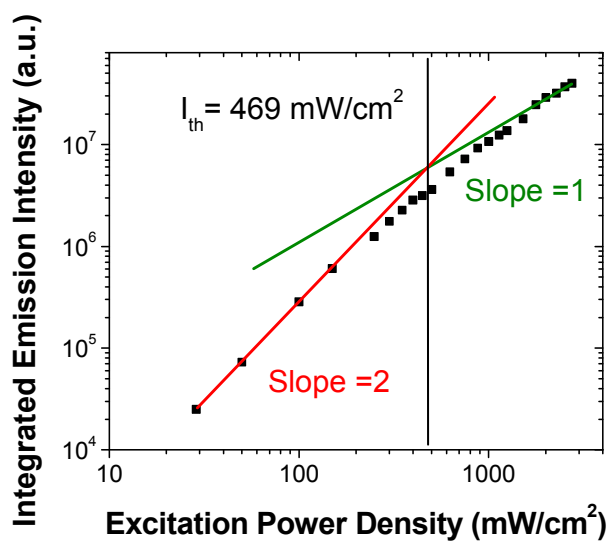


Figure S2. Integrated emission intensity from 460-480 nm from ZrO₂-A-Zn-S with respect to 532 nm excitation intensity (532 nm notch filter).

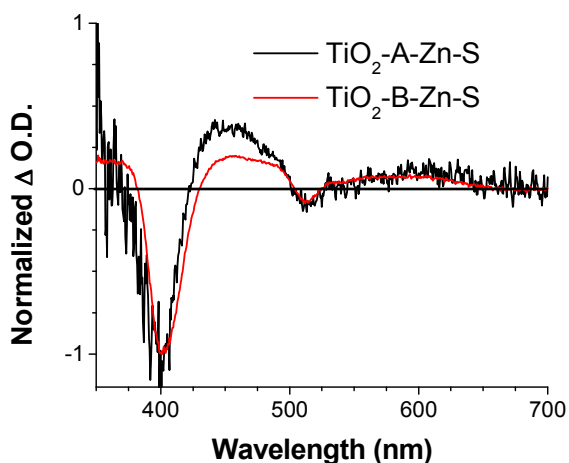


Figure S3. Normalized nanosecond transient absorption spectra of TiO₂-A-Zn-S (black) and TiO₂-B-Zn-S (red) excited at 532 nm and monitored at 0 ns delay.

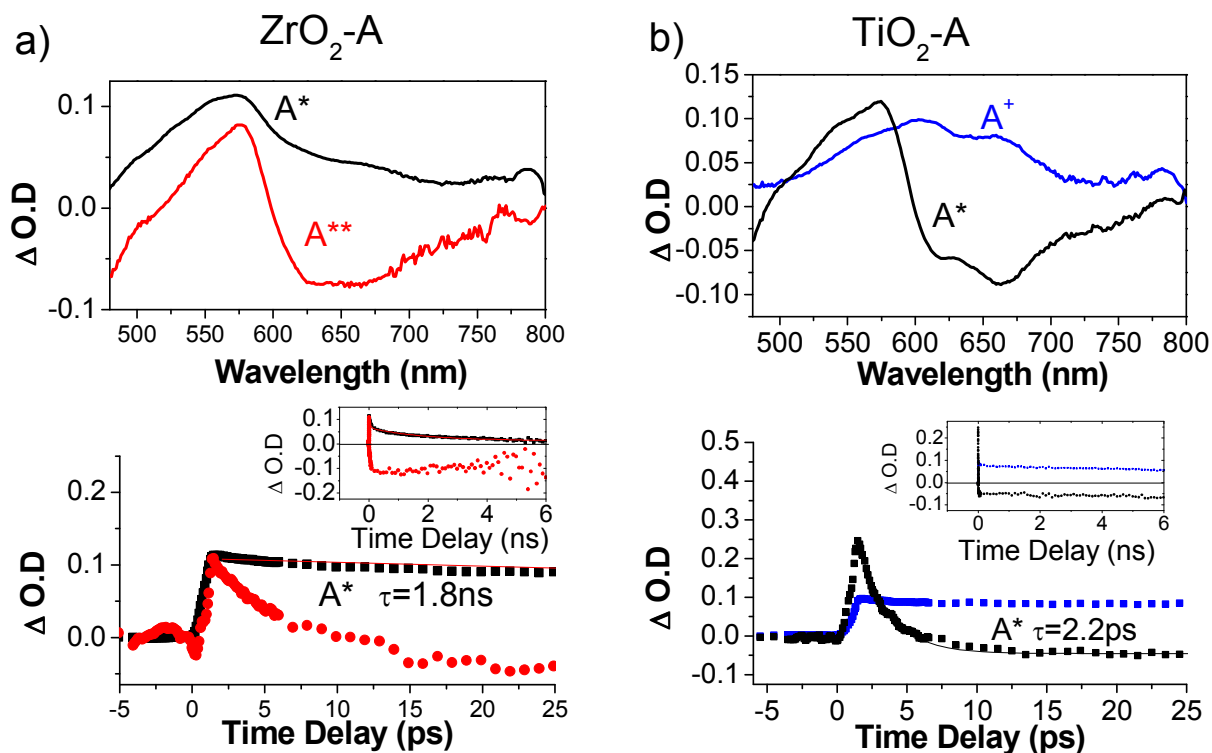


Figure S4. Principle spectral (top) and kinetic (bottom) components obtained from the Singular Value Decomposition (SVD) analysis of ultrafast transient absorption spectra of a) ZrO₂-A and b) TiO₂-A. In both cases the excitation wavelength was $\lambda_{\text{ex}}=400$ nm.

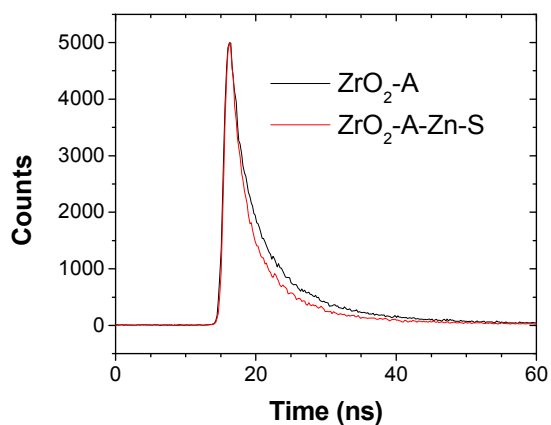


Figure S5. Time resolved emission spectra of $\text{ZrO}_2\text{-A}$ (black) and $\text{ZrO}_2\text{-A-Zn-S}$ (red) excited at 360 nm and monitoring A emission at 460 nm to determine k_{ET} .

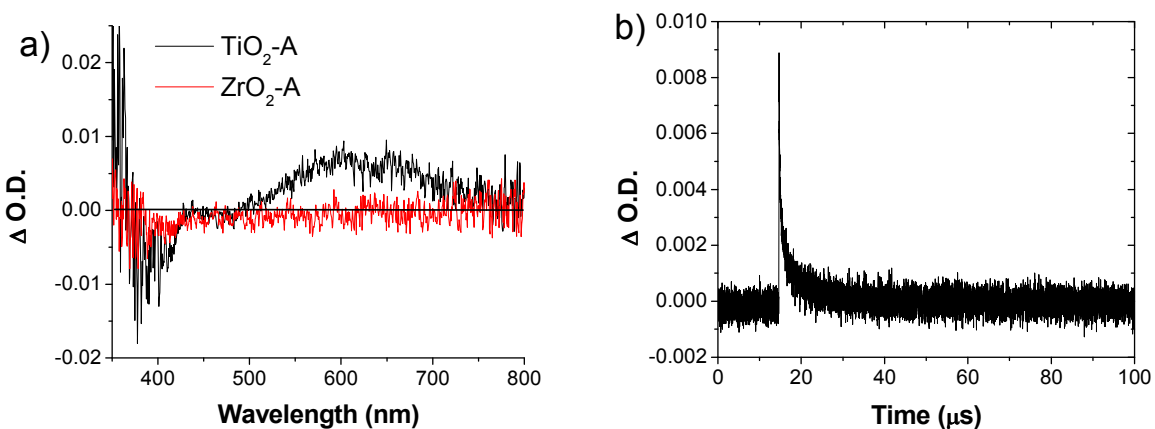


Figure S6. Full spectra (a) and time resolved (b) nanosecond transient absorption spectroscopy of $\text{TiO}_2\text{-A}$ (black) and $\text{ZrO}_2\text{-A}$ (red) exciting at 360 nm and monitoring the decay of the acceptor cations at 600 nm with emission correction and 375 nm LP filter to determine k_{BET1} .

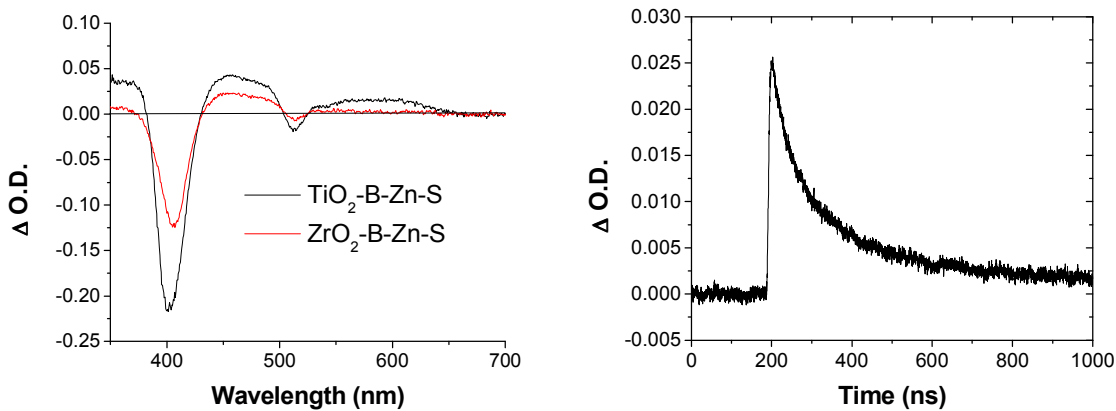


Figure S7. Full spectra (a) and time resolved (b) nanosecond transient absorption spectroscopy of TiO_2 -B-Zn-S (black) and ZrO_2 -B-Zn-S (red) exciting at 532 nm and monitoring the decay of the sensitizer cations at 600 nm with emission correction and 532 nm notch filter to determine k_{BET2} .

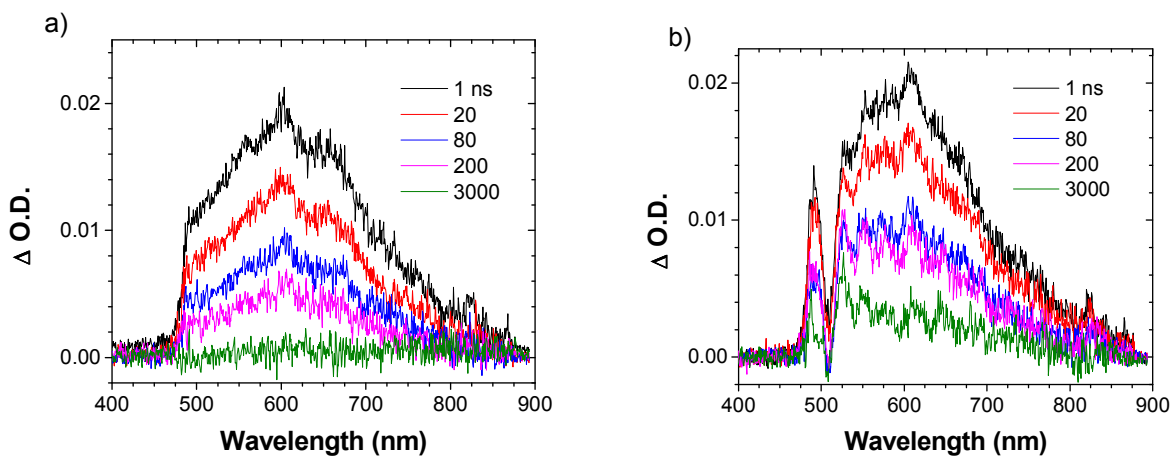


Figure S8. Full spectra nanosecond transient absorption spectroscopy of (a) TiO_2 -A and (b) TiO_2 -A-Zn-S exciting at 360 nm and monitoring the decay of the acceptor cations with a 495 nm LP filter to determine k_{eT} .

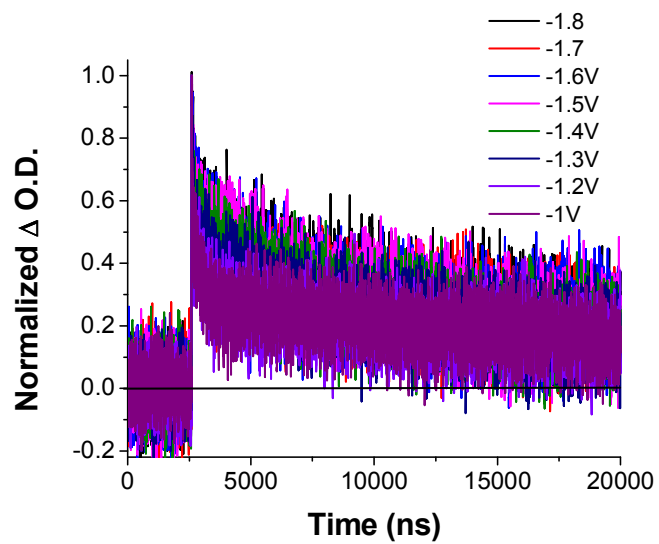


Figure S9. Time resolved nanosecond transient absorption spectroscopy of TiO₂-A-Zn-S excited at 532 nm and monitoring the decay of the triplet acceptor at 430 nm with increasingly negative applied potential bias.