Rapid Recombination in Dye-Sensitized Core/Shell Films

Scientific Achievement

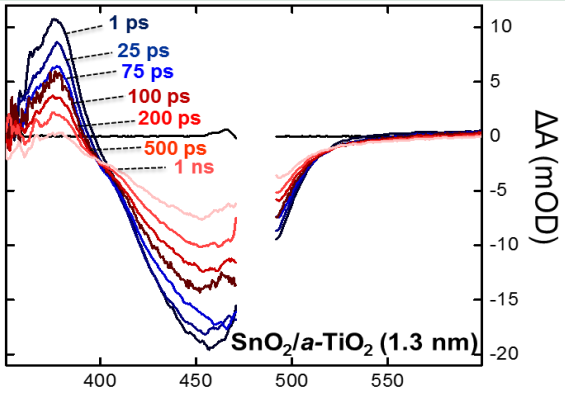
Mapped the injection and recombination dynamics on dye-sensitized SnO_2/TiO_2 core/shell films from femtoseconds through milliseconds.

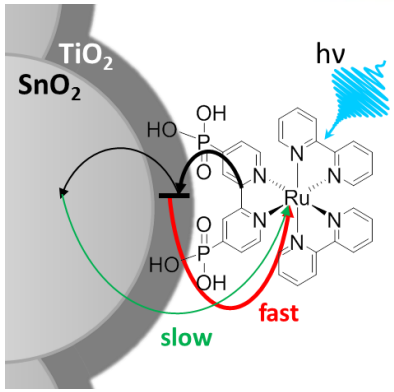
Significance and Impact

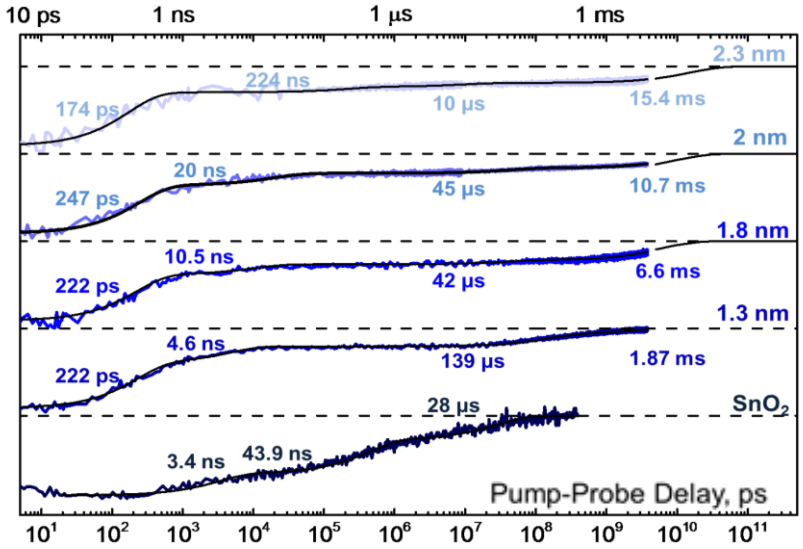
Uncovers why DSPEC devices benefit from use of core/shell films and their limitations. To continue to improve device efficiencies, ultrafast recombination must be suppressed.

Research Details

- Photoexcited chromophore injects electrons into amorphous TiO_2 shell with rates independent of shell thickness.
- Majority (60%) of injected electrons recombine with oxidized chromophore in < 1 ns (τ ~250 ps).
- Small portion of injected electrons transfer to SnO_2 core and must tunnel through shell to recombine (τ ~ms).







Top: TA of RuP on core/shell film with 1.3 nm TiO_2 thickness. Red denotes behavior unique to core/shell films.

Bottom: Bleach recombination kinetics for shells of varying thickness from fs through ms. Signals are offset for clarity.

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Work was performed at the University of North Carolina at Chapel Hill