Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Improved Charge Carrier Dynamics in Polymer/Perovskite Nanocrystal Based Hybrid Ternary Solar Cells

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‡ Both authors contribute to the same parts to the paper

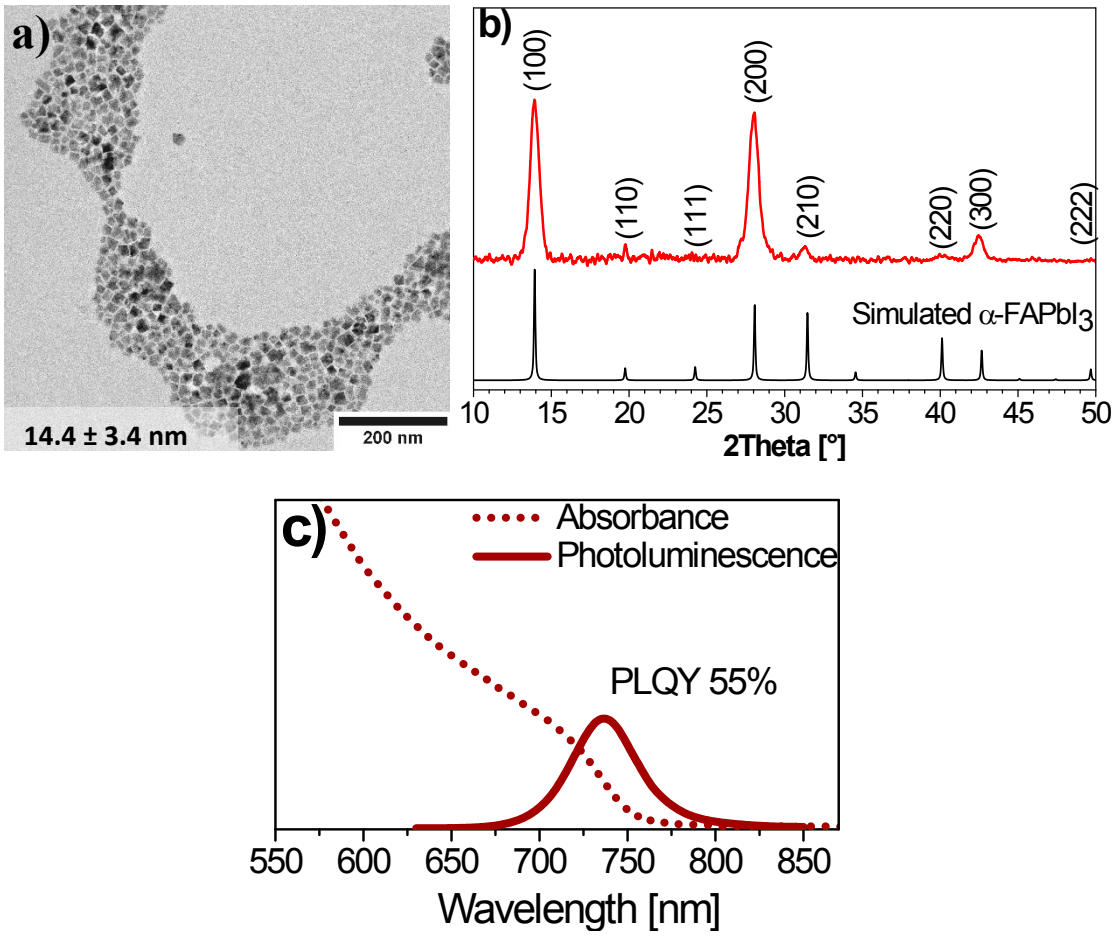


Figure S1. a) TEM micrograph of the monolayer Organolead Iodide Perovskite NCs on a grid. b) XRD of the α-$FAPbI_3$ Perovskite NCs sample. Simulated data are based a reference for cubic "black" α-phase from Stoumpos et al. (Inorg. Chem. 2013, 52, 9019-9038.) and c) Absorbance and photoluminescence spectra $FAPbI_3$ NCs in toluene solution.

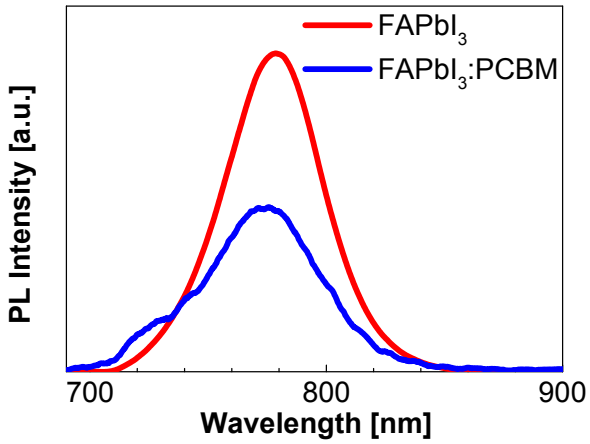


Figure S2. PL spectra of the films comprising $FAPbI_3$ and $FAPbI_3$: $PC_{61}BM$ (1:1 weight ratio).

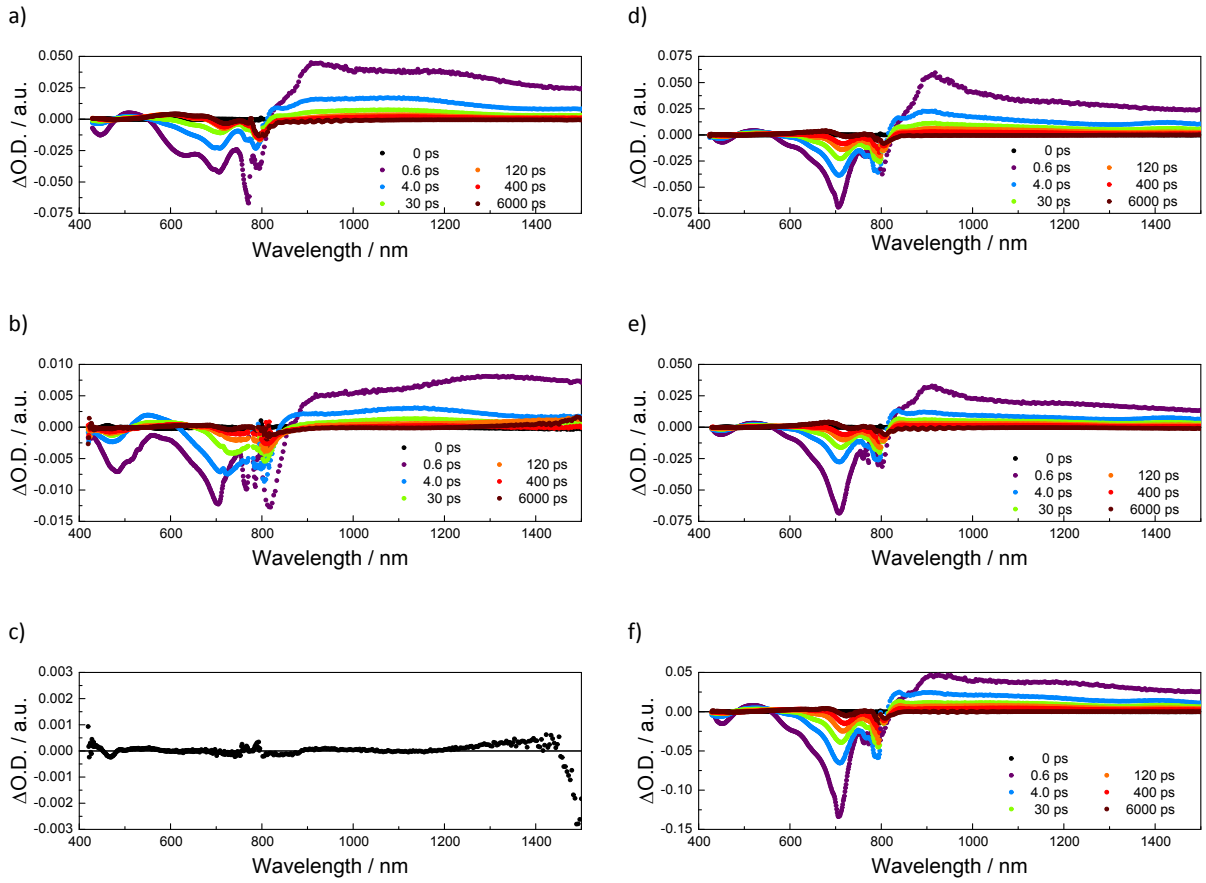


Figure S3. Differential absorption spectra obtained from femtosecond pump-probe experiments (775 nm) under inert atmosphere at room temperature of a) DPP; b) the binary blends DPP:FAPbI3; c) PC61BM:FAPbI3; d) and DPP:PC61BM; as well as of e) ternary blends comprising 5 and f) 10 wt.% FAPbI3 NCs.

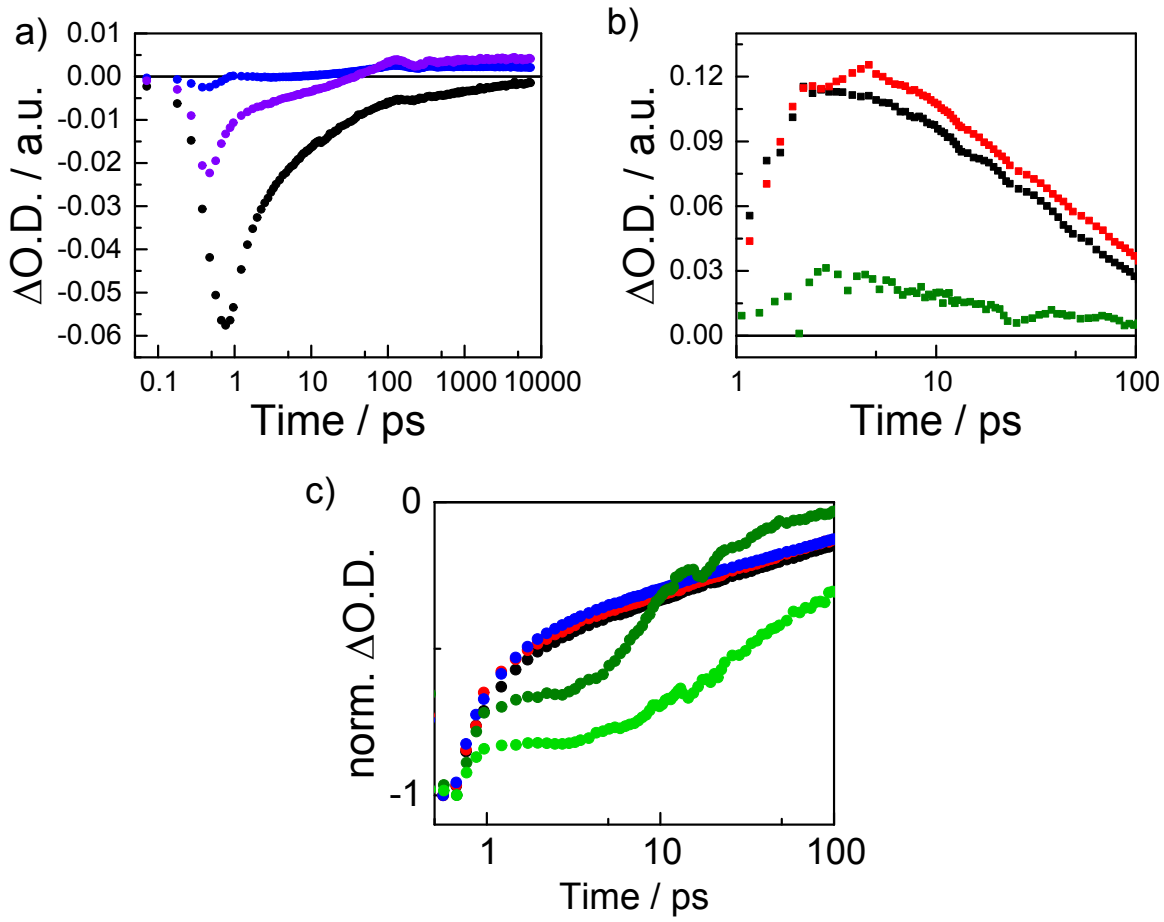


Figure S4. Transient absorption kinetic trace signals obtained upon femtosecond pump-probe experiments (775 nm) under inert atmosphere at room temperature. a) DPP measured at 705 nm (GSB; black), 557 nm (triplet excited state signal; blue), and 600 nm (singlet and maximum triplet excited state signal; purple); b) DPP's cation signal at 1437 nm for DPP:$PC_{61}BM$ (black), DPP:$FAPbI_3$ (green), and DPP:$FAPbI_3$ (5 wt.%):$PC_{61}BM$ (red), derived by subtracting the DPP's singlet excited state signal; c) Normalized kinetic traces of the ground state bleach signals of DPP:$PC_{61}BM$ (black), DPP:$FAPbI_3$:$PC_{61}BM$ with 5 wt.% (red) and 10 wt.% NCs (blue) at 704 nm, as well as DPP:$FAPbI_3$ at 681 nm (higher DPP content, dark green) and 756 nm (higher $FAPbI_3$ content, light green).

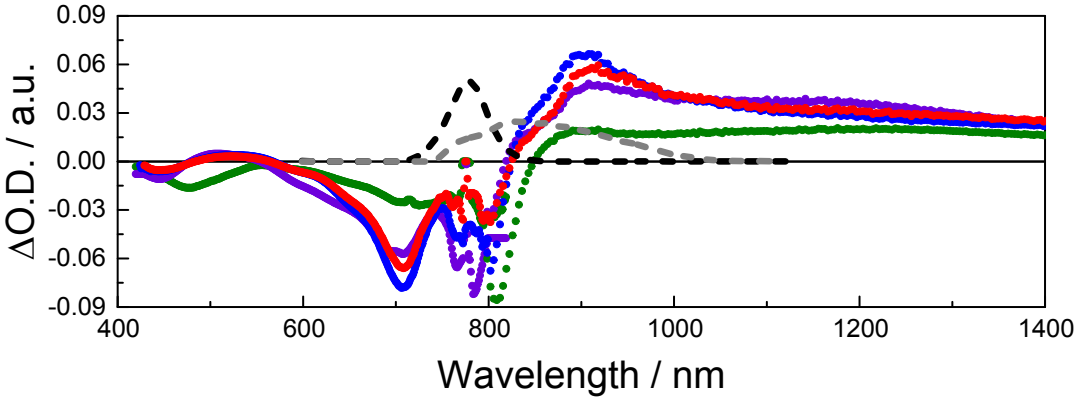


Figure S5. Circle symbols represent the differential absorption spectra obtained upon femtosecond pump-probe experiments (775 nm) under inert atmosphere at room temperature of DPP (purple), DPP:$PC_{61}BM$ (blue), DPP:$FAPbI_3$ (3x enhanced, green), and DPP:$FAPbI_3$(5%):$PC_{61}BM$ (red) after 600 fs. dashed lines are the PL spectra of DPP:$FAPbI_3$ (grey) and $FAPbI_3$ (black).

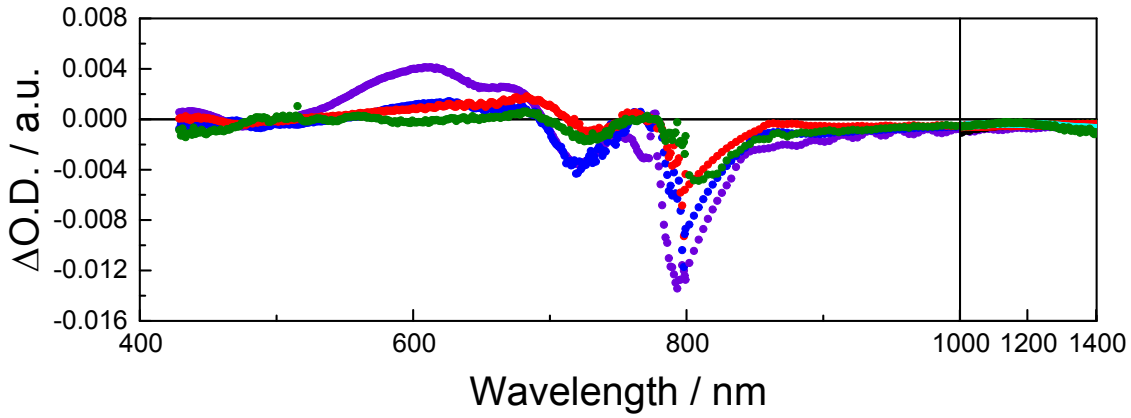
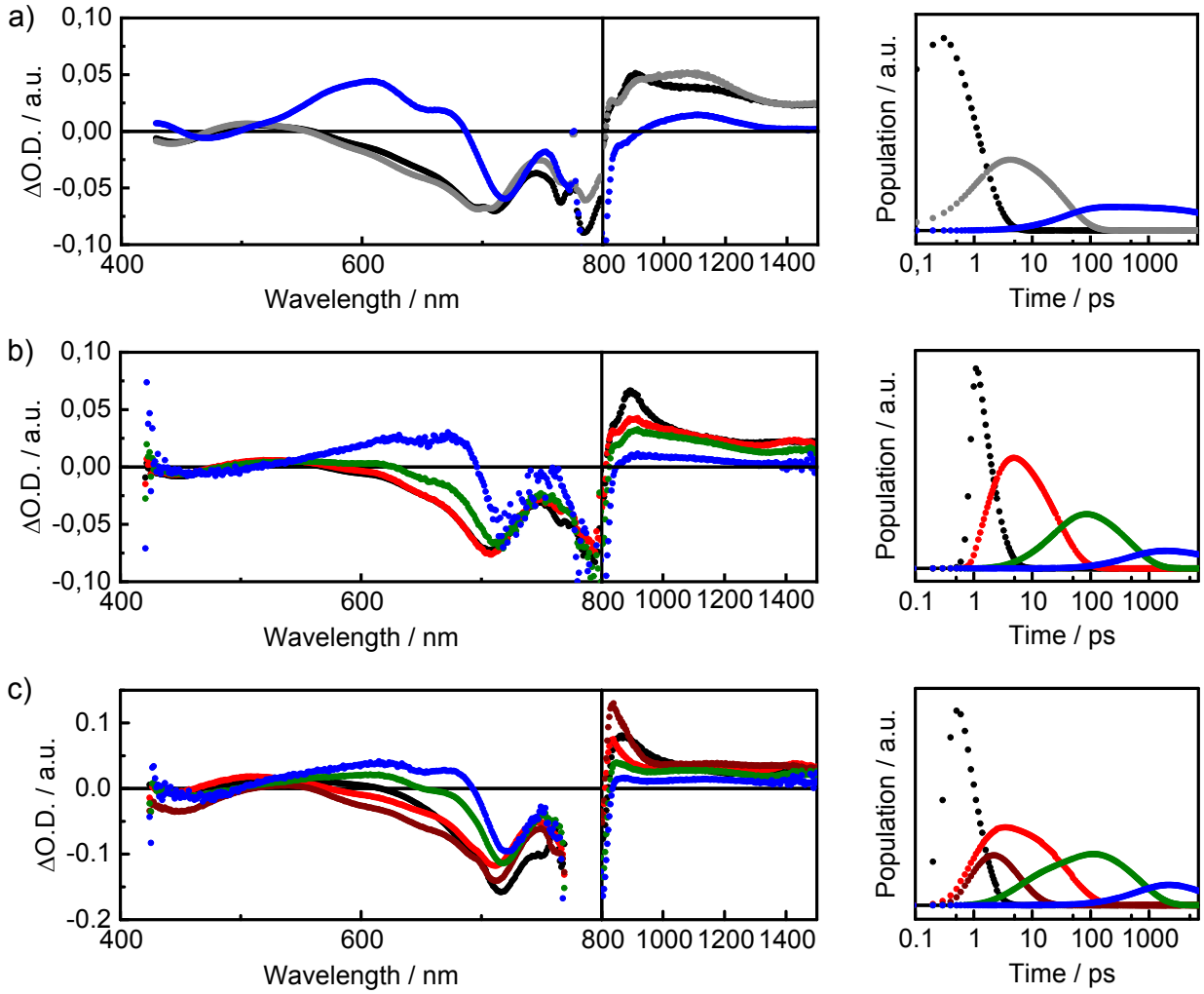


Figure S6. Differential absorption spectra of DPP (purple), DPP:$PC_{61}BM$ (blue), DPP:$FAPbI_3$ (3x enhanced, green), and DPP:$FAPbI_3$(5%):$PC_{61}BM$ (red) after 6 ns.



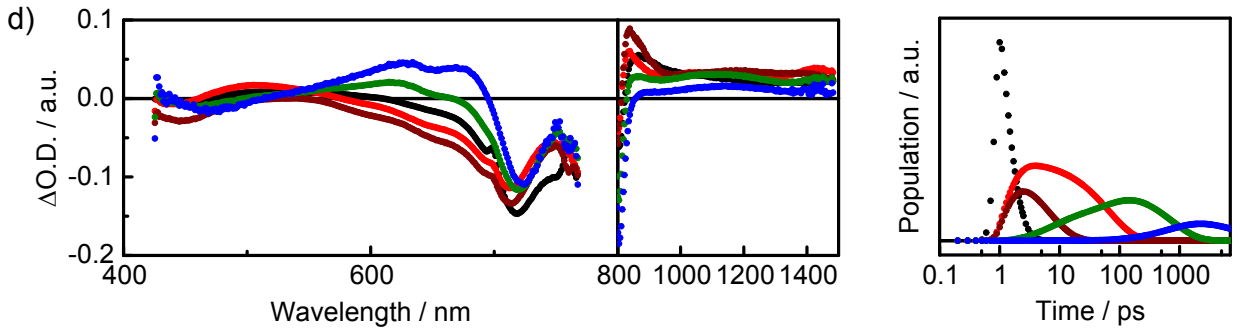


Figure S7. Species associated spectra (left) and state population (right) of a) DPP; b) DPP:$PC_{61}BM$; and c) ternary blends comprising 5 and d) 10 wt.% $FAPbI_3$ NCs showing DPP's singlet (black), intramolecular charge-transfer interaction of DPP (grey), the bound charge carriers located at the interface between DPP and either $PC_{61}BM$ (red) or $FAPbI_3$ (dark red), the separated charge carriers in DPP and $PC_{61}BM$ (green) as well as DPP's triplet (blue) like presented in the models.

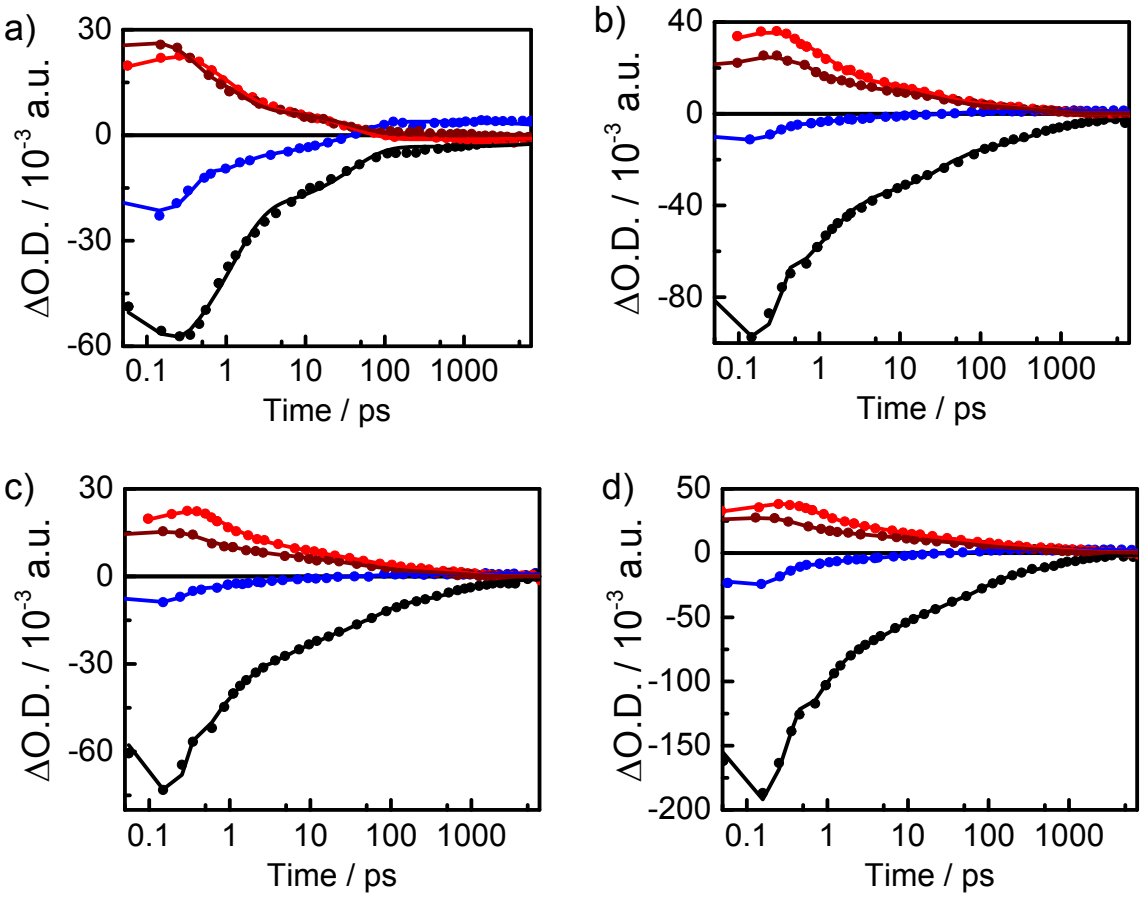


Figure S8. Differential absorption kinetics of a) DPP; b) DPP:$PC_{61}BM$; and c) ternary blends comprising 5 and d) 10 wt.% $FAPbI_3$ NCs showing the traces of the GSB (705 nm, black), the maximum of the triplet excited state peak (600 nm, blue), and the two main signals combining DPP's singlet excited state and cation (850 nm, light red; 1437 nm, dark red). The solid lines represent fitted curves using the model presented in Figure 6a, and a sequential one that includes radiative recombination for DPP.

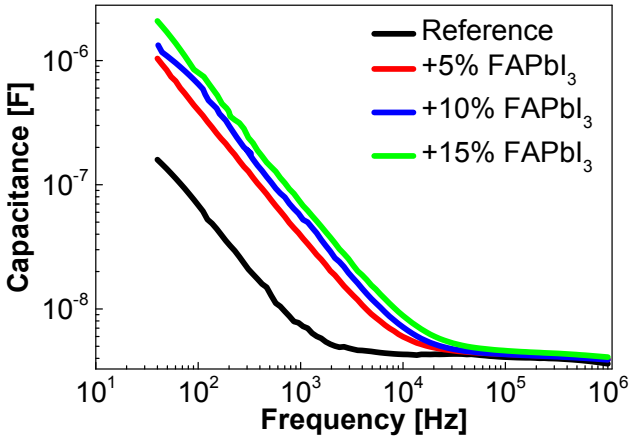


Figure S9. Capacitance as a function of frequency for the reference binary and ternary devices comprising various amount of $FAPbI_3$ perovskite NCs.