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Efficiency Increase of Organic Solar Cells with Emissive Light-in-coupling Layers

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Supplementary Information

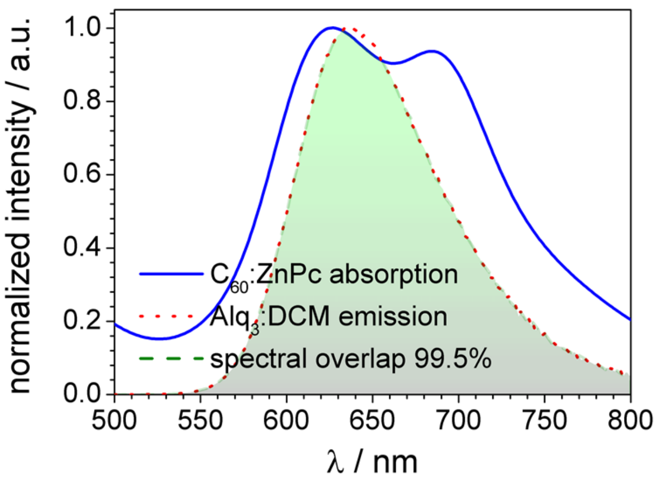

Figure S1. Spectral overlap of the emission spectrum originating from Alq_3:DCM and the absorption spectrum of C_{60}:ZnPc blends.

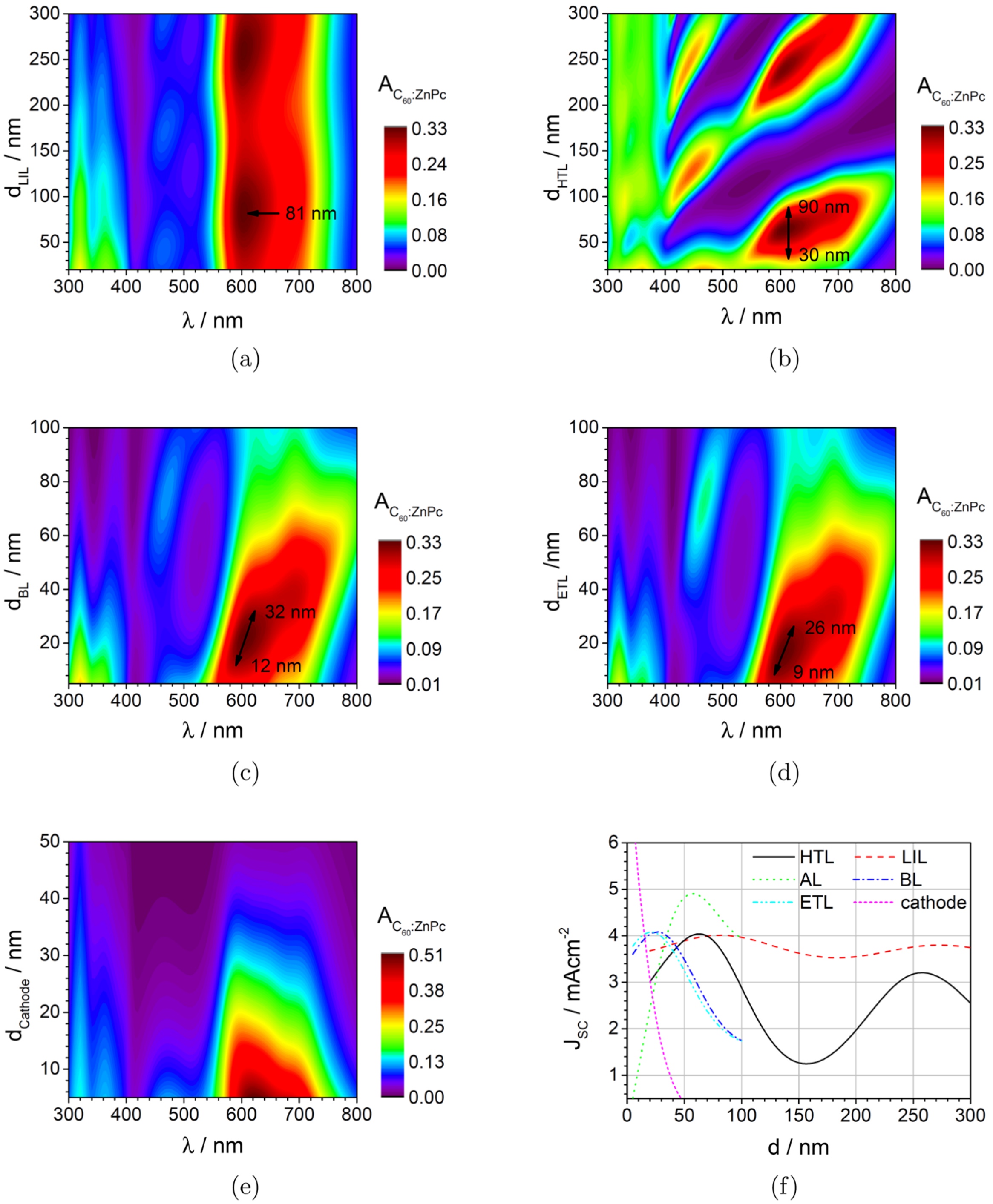

Figure S2. Optical simulation of the absorptivity of the absorption layer C_{60}:ZnPc for different layer thicknesses of the DCM free LIL (a), p-HTL (b), BL (c), ETL (d) and the semitransparent cathode (e). If not varied for the plot, the thicknesses were 80 nm Ag, 60 nm p-HTL, 35 nm AL, 20 nm BL, 15 nm ETL, 15 nm Ag, 80 nm undoped LIL. The subfigure (f) shows the predicted J_{SC} generated by the AL assuming the AM 1.5 spectrum for the variation of each layer thickness.

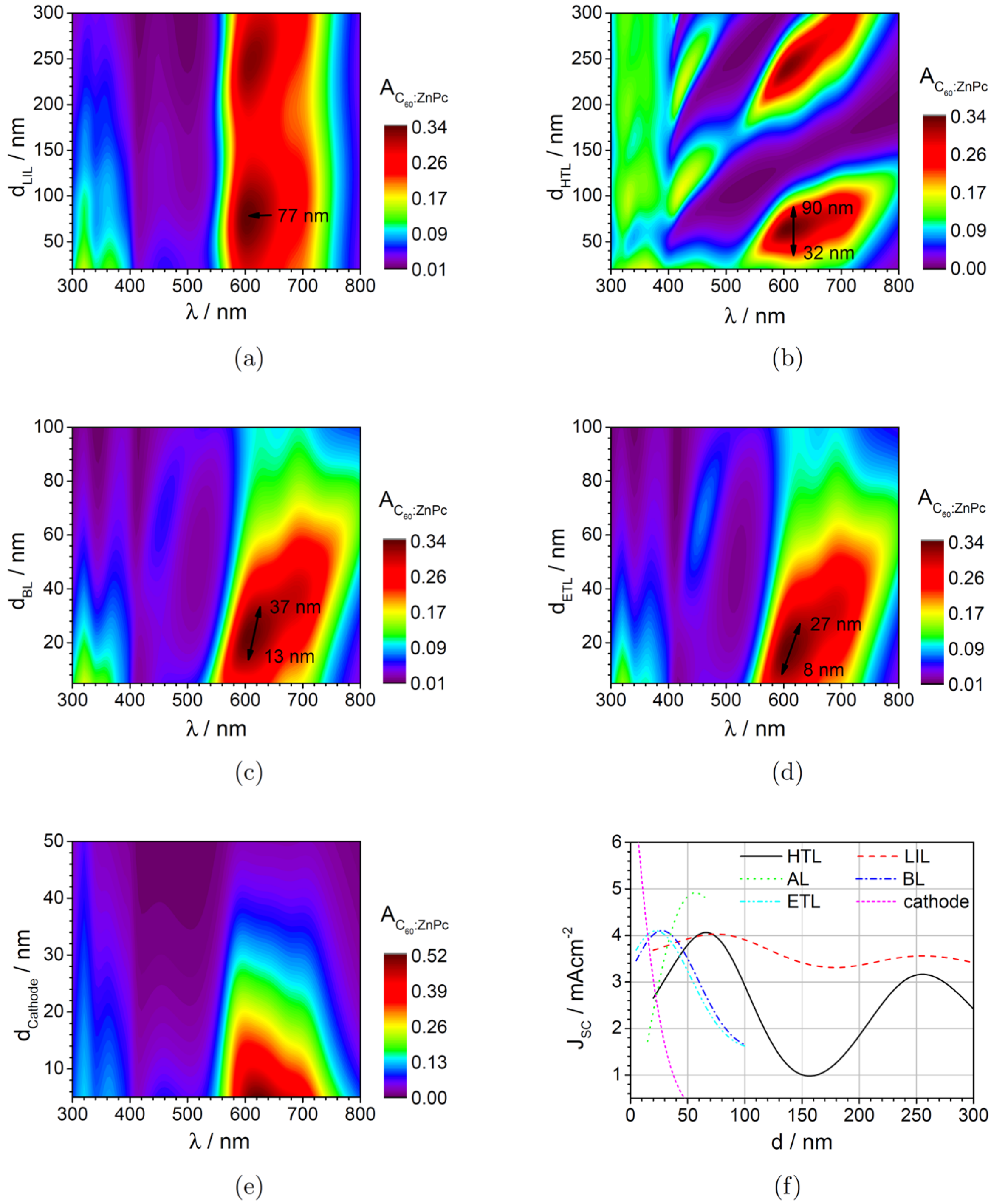

Figure S3. Optical simulation of the absorptivity of the absorption layer C_{60}:ZnPc for various values of the layer thickness of the LIL doped with DCM (a), p-HTL (b), BL (c), ETL (d) and the semitransparent cathode (e). If not varied for the plot, the thicknesses were 80 nm Ag, 60 nm p-HTL, 35 nm AL, 20 nm BL, 15 nm ETL, 15 nm Ag, 80 nm LIL doped with DCM. The subfigure (f) shows the predicted J_{SC} generated by the AL assuming the AM 1.5 spectrum for the variation in thickness of each layer.

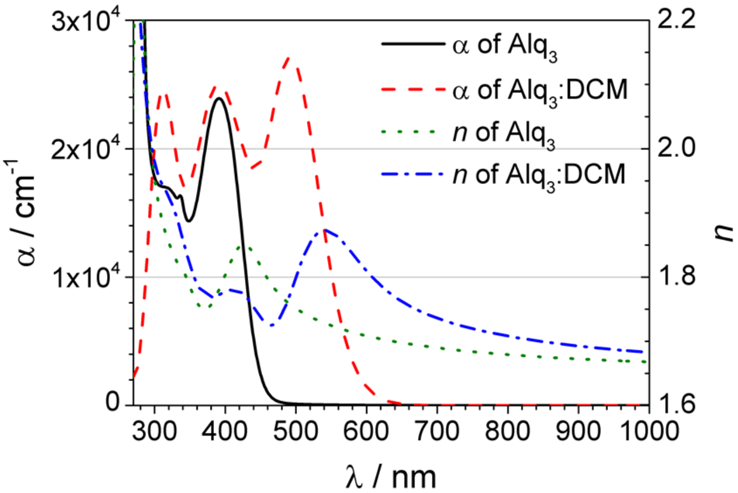

Figure S4. Optical constants α and n for pure Alq_3 and doped Alq_3 with 10wt% DCM.

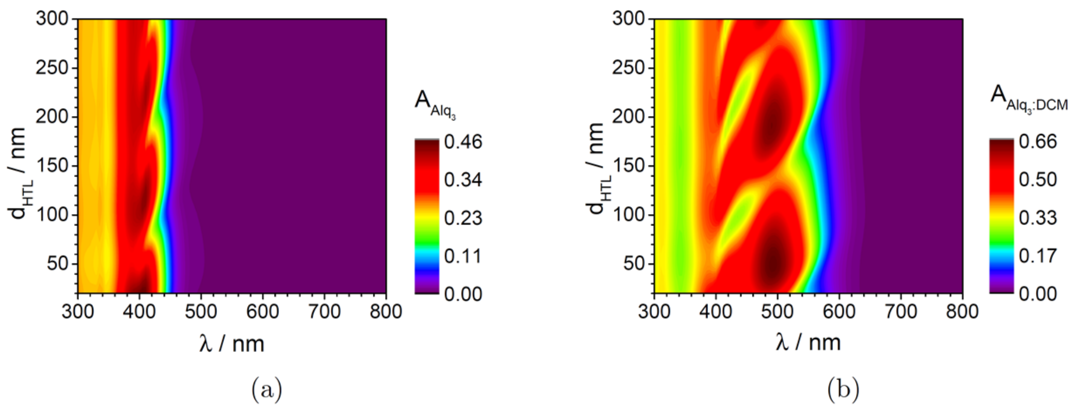

Figure S5. Optical simulation of the absorption behaviour of (a) pure Alq_3 and (b) Alq_3:DCM thin films doped with 10 wt% DCM in dependence on the HTL layer thickness.

The absorption bands of Alq_3 can easily be assigned in spectra from the mixed Alq_3:DCM thin film, which additionally feature an absorption band occurring at 490 nm, due to DCM absorption (cf. S4). With respect to the low DCM concentration of 10 wt%, the value of the absorption coefficient at that wavelength is remarkable (λ(490 nm) = 2.7×10^4 cm^{-1}), suggesting a strong transition dipole moment and a medium with a high polarity. According to the optical simulation, more photons will be absorbed by the doped LIL in the region from 300 to 530 nm (A = 0.33 - 0.66) than all photons absorbed by the AL from 550 to 750 nm. The absorption profiles of the LILs with and without DCM are depicted in S5. Furthermore, the maximum absorption of the LIL can also be tuned by varying the HTL thickness.