Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information:
Absorptive Carbon Nanotube Electrodes:
Consequences of Optical Interference Loss in Thin Film Solar Cells

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Video S1. An animation of the ultrasonic spray coating of MWCNTs through a mask is included in the supporting information.

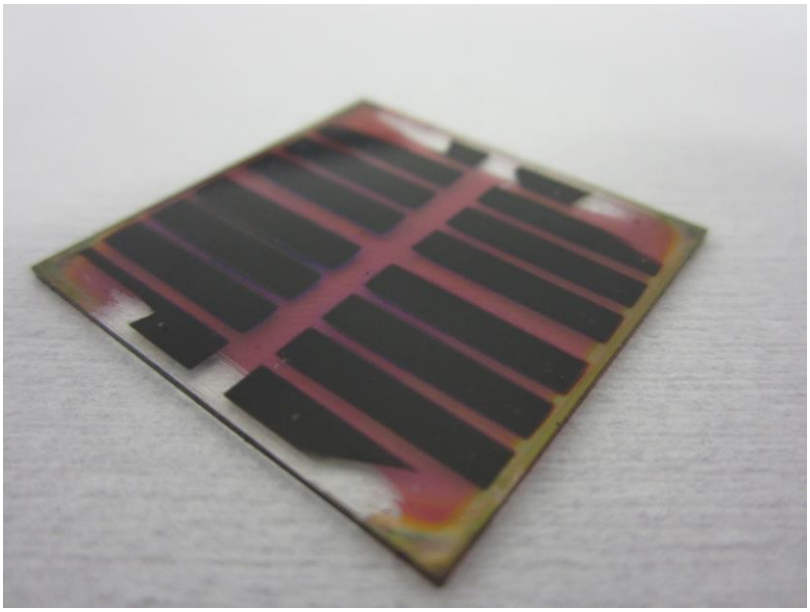

Figure S1. Photograph of devices fabricated with sprayed absorptive MWCNT electrodes. The substrate is 3x3 cm.

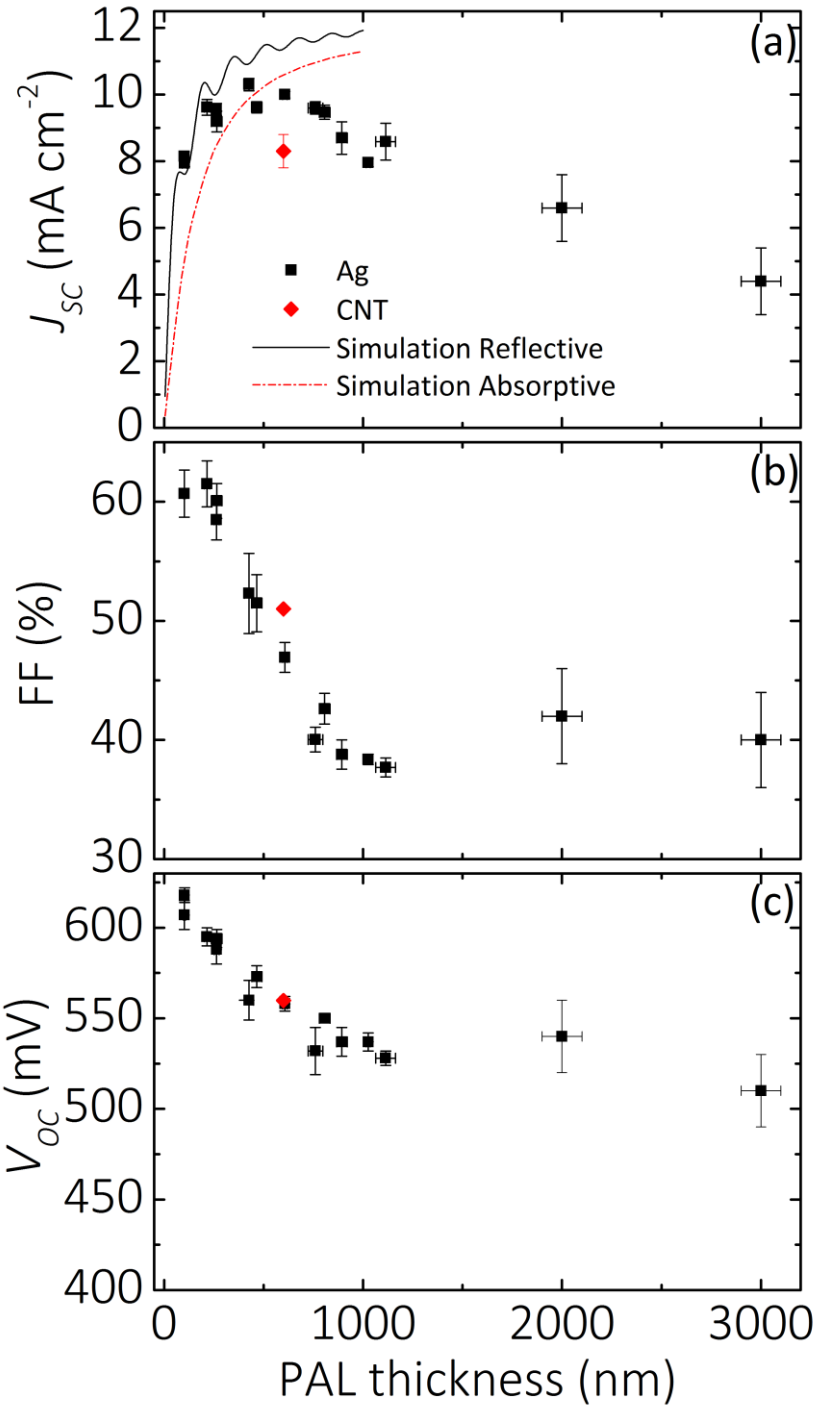

Figure S2. Plots of (a) short circuit current density (J_{SC}), (b) fill factor (FF), and (c) open circuit voltage (V_{OC}) vs. PAL thickness for measured inverted architecture devices with Ag (black squares) and CNT (red diamonds) electrodes. Optically simulated J_{SC} values for the reflective (solid black line) and absorptive (dashed red line) electrode devices are shown.

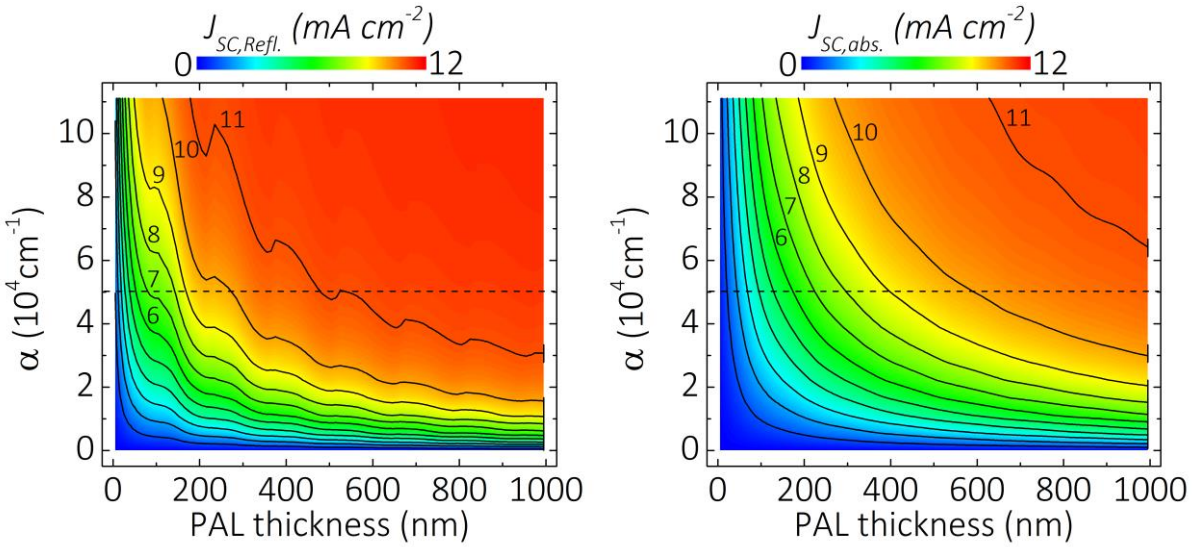

Figure S3. Contour plot showing the simulated maximum J_{SC} reflective Ag (left) and absorptive (right) electrodes as a function of thickness and absorption strength, signified by the absorption coefficient (α) at 563 nm (peak of P3HT:PCBM absorption). The dashed contour line represents the measured absorption coefficient of 5x10^4 cm^{-1} of P3HT:PCBM.

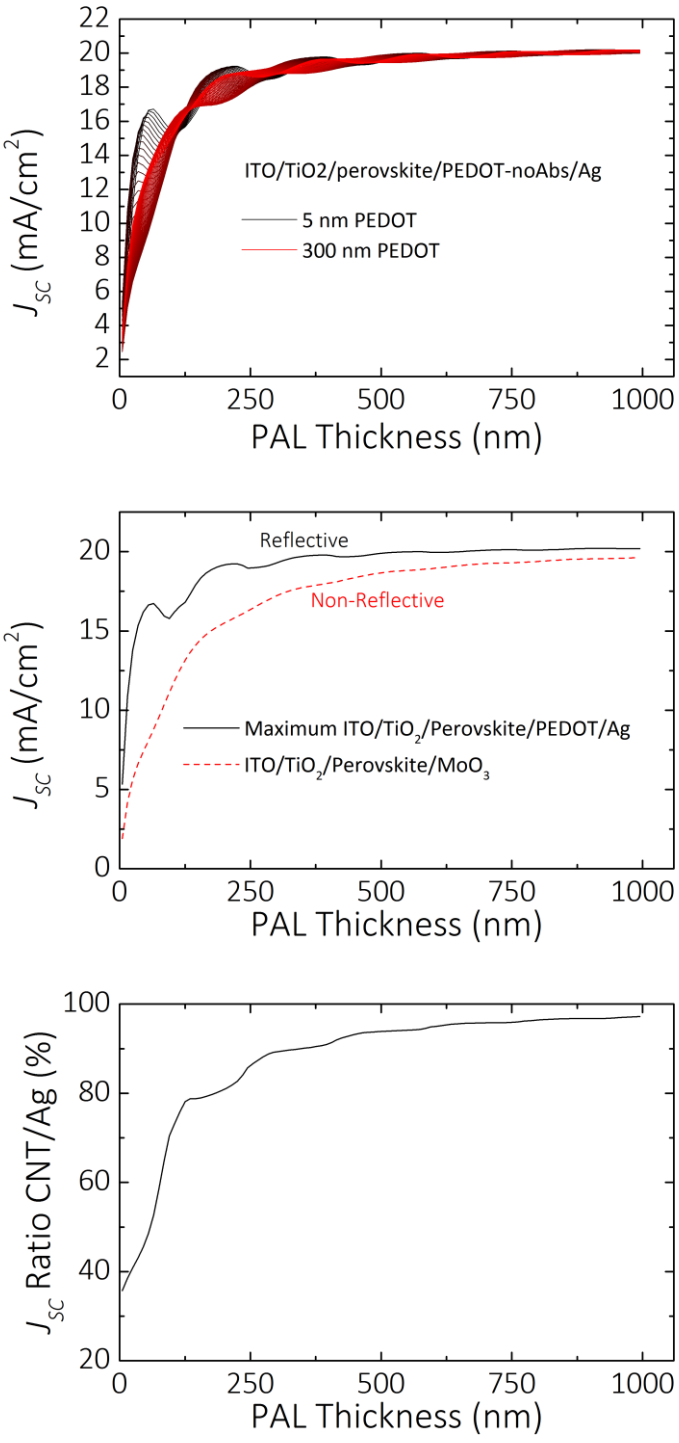

Figure S4. The top figure shows optically simulated J_{SC} production of perovskite-based photovoltaic devices as a function of PAL thickness, red to black curves show varied thickness of a non-absorbing PEDOT:PSS-like optical spacer. The middle figure shows the maximum J_{SC} for all simulated thicknesses PEDOT thickness, along with the production with a perfect absorber top contact. The bottom figure shows the ratio of absorptive to reflective electrode devices.

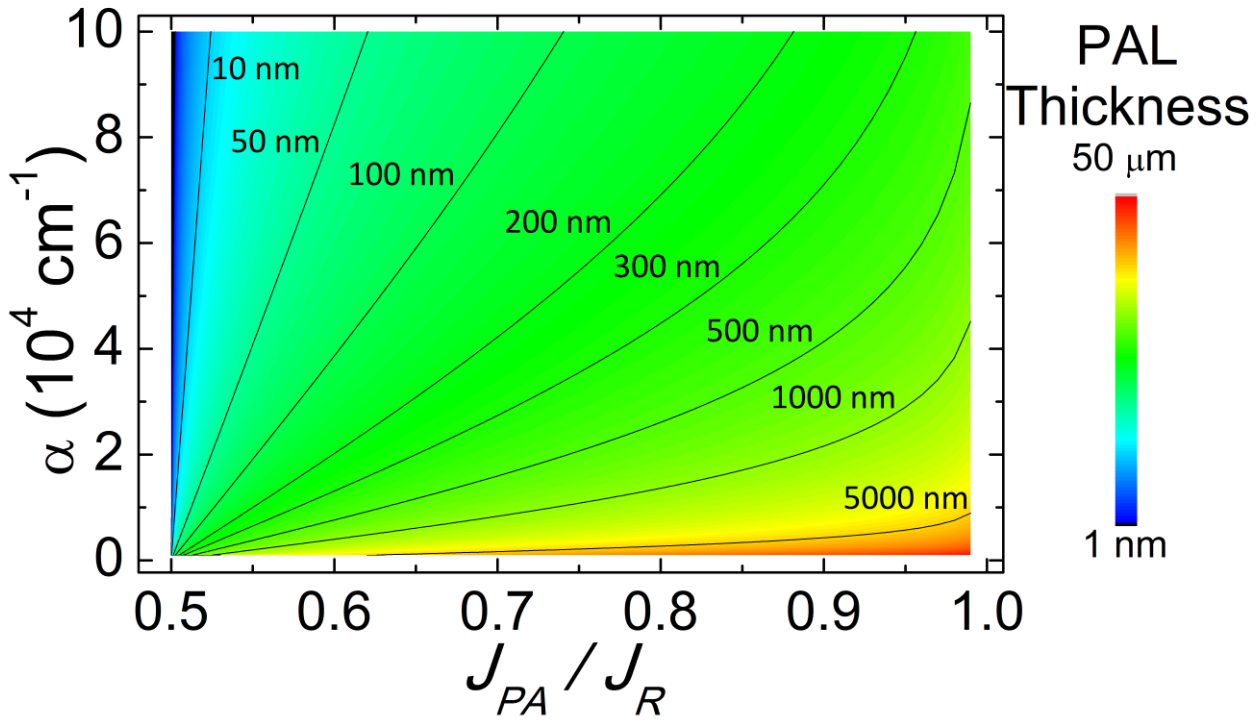

Figure S5. Contour plot of the simplified equation for the ratio of photocurrents produced in devices with a perfect absorber vs. a reflective Ag electrode. The y-axis is the absorption coefficient at a specific wavelength, the x-axis is the ratio of photocurrents, and the z-axis color spectrum is the photoactive layer thickness required to achieve the x- and y-axis specifications. The z-axis is logarithmic and has contour lines on the plot.