Supporting information for:

Optimizing the Energy Offset Between Dye and Hole-Transporting Material in Solid-State Dye-Sensitized Solar Cells

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Chemical Oxidation of HTM Solution Through Titration with $NOBF_4$

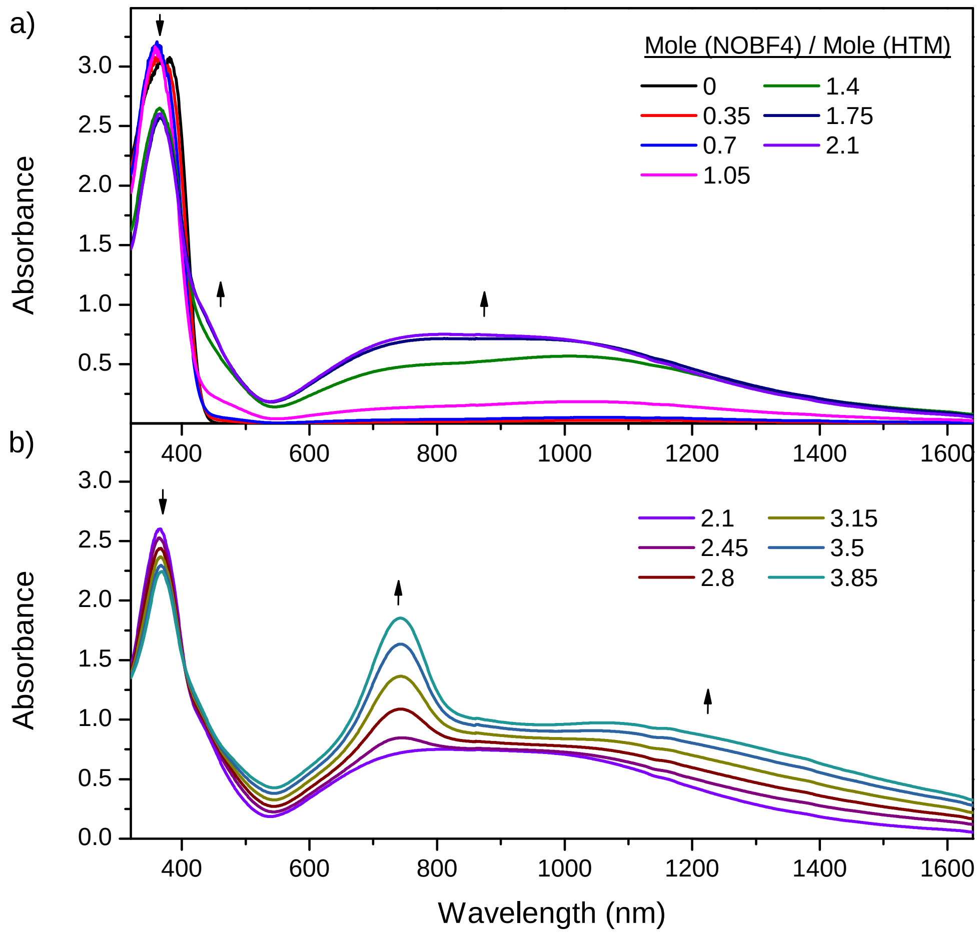

Figure S1: Stepwise chemical oxidation of 4×10^{-4} M HTM **1** in acetonitrile and chlorobenzene (1:1) with increasing amounts of $NOBF_4$: (a) From HTM $\mathbf{1}^0$ over HTM $\mathbf{1}^+$ to HTM $\mathbf{1}^{2+}$, (b) from HTM $\mathbf{1}^{2+}$ towards higher oxidized states.

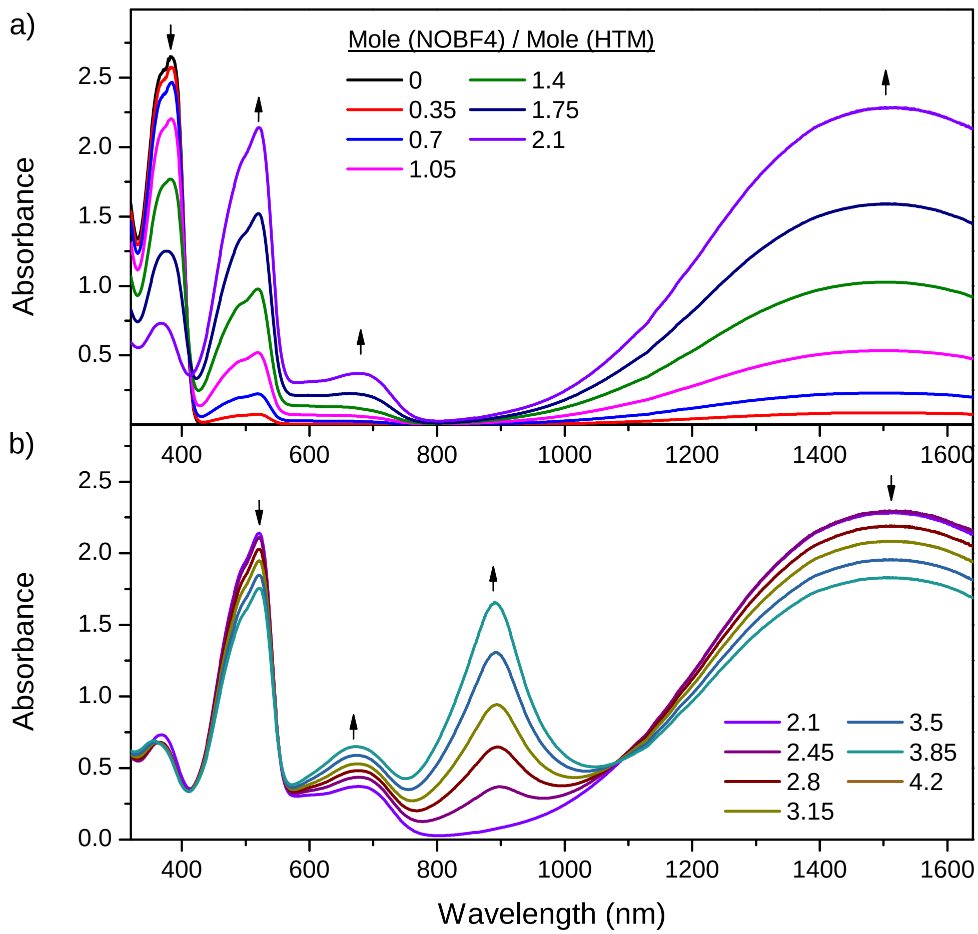

Figure S2: Stepwise chemical oxidation of 4×10^{-4} M spiro-OMeTAD in acetonitrile and chlorobenzene (1:1) with increasing amounts of $NOBF_4$: (a) From spiro-OMeTAD^0 over spiro-OMeTAD$^+$ to spiro-OMeTAD^{2+}, (b) from spiro-OMeTAD^{2+} towards spiro-OMeTAD^{4+}.

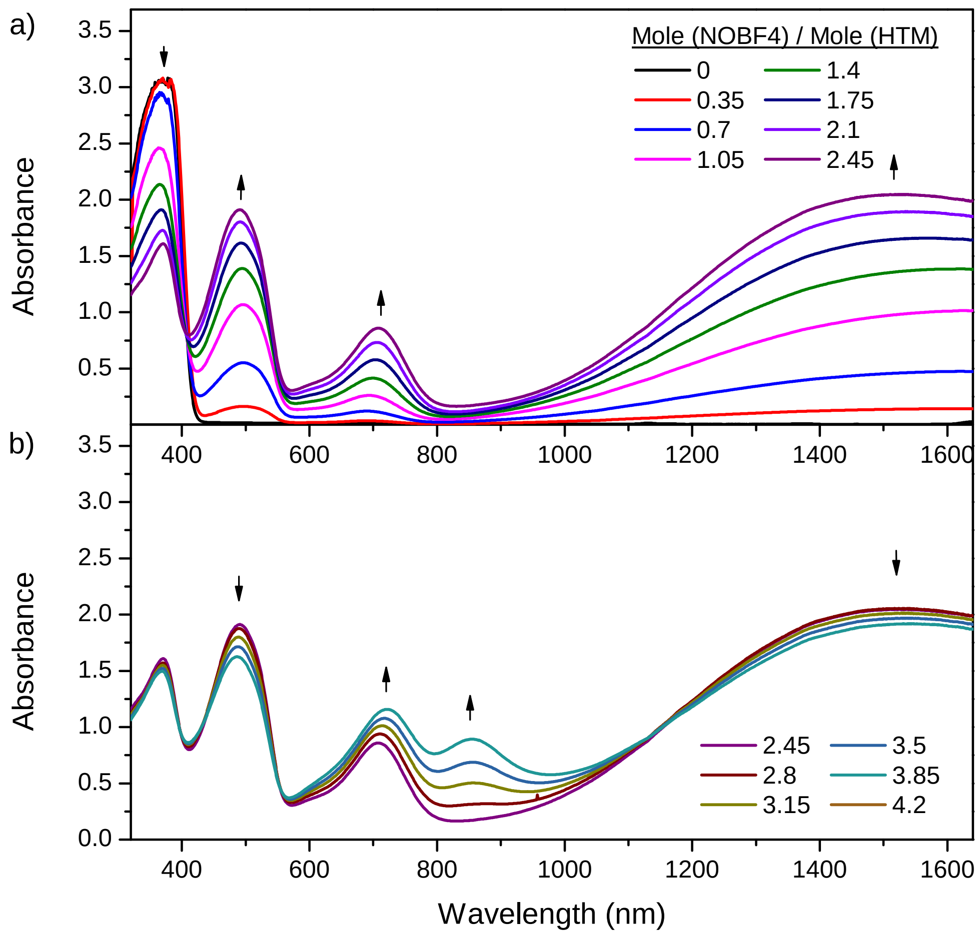

Figure S3: Stepwise chemical oxidation of 4×10^{-4} M HTM **2** in acetonitrile and chlorobenzene (1:1) with increasing amounts of $NOBF_4$: (a) From HTM $\mathbf{2}^0$ over HTM $\mathbf{2}^+$ to HTM $\mathbf{2}^{2+}$, (b) from HTM $\mathbf{2}^{2+}$ towards higher oxidized states.

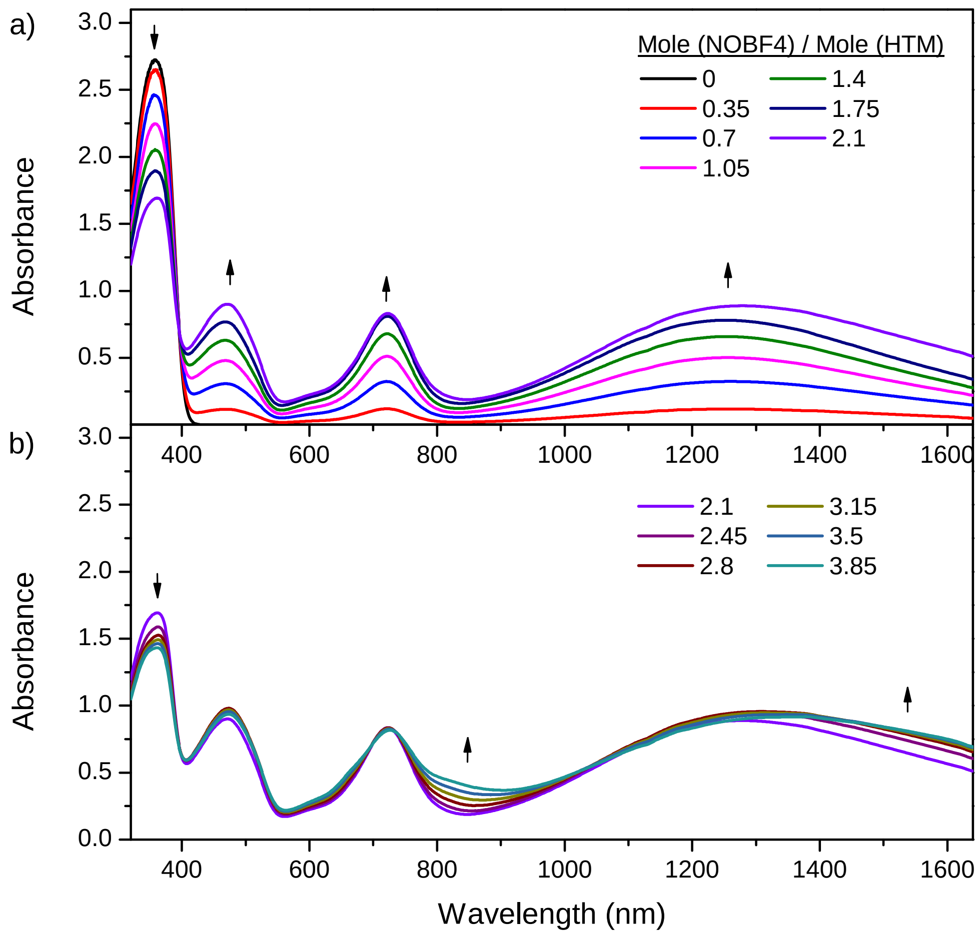

Figure S4: Stepwise chemical oxidation of 4×10^{-4} M HTM **3** in acetonitrile and chlorobenzene (1:1) with increasing amounts of $NOBF_4$: (a) From HTM $\mathbf{3}^0$ over HTM $\mathbf{3}^+$ to HTM $\mathbf{3}^{2+}$, (b) from HTM $\mathbf{3}^{2+}$ towards higher oxidized states.

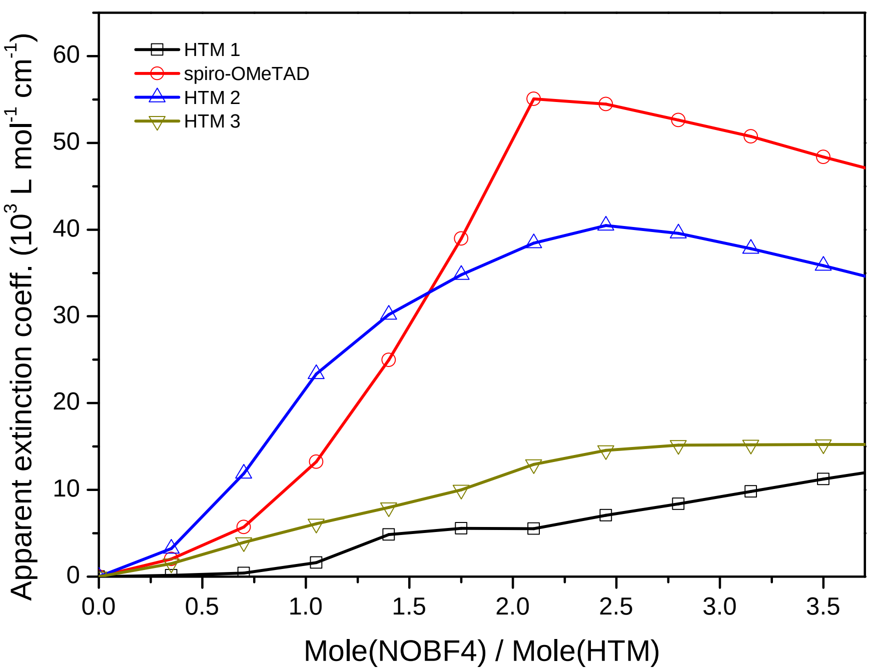

Figure S5: Stepwise chemical oxidation at 520 nm of the four different hole-transporting materials for varying concentrations of $NOBF_4$.

Cyclic Voltammetry of Hole-Transporting Materials

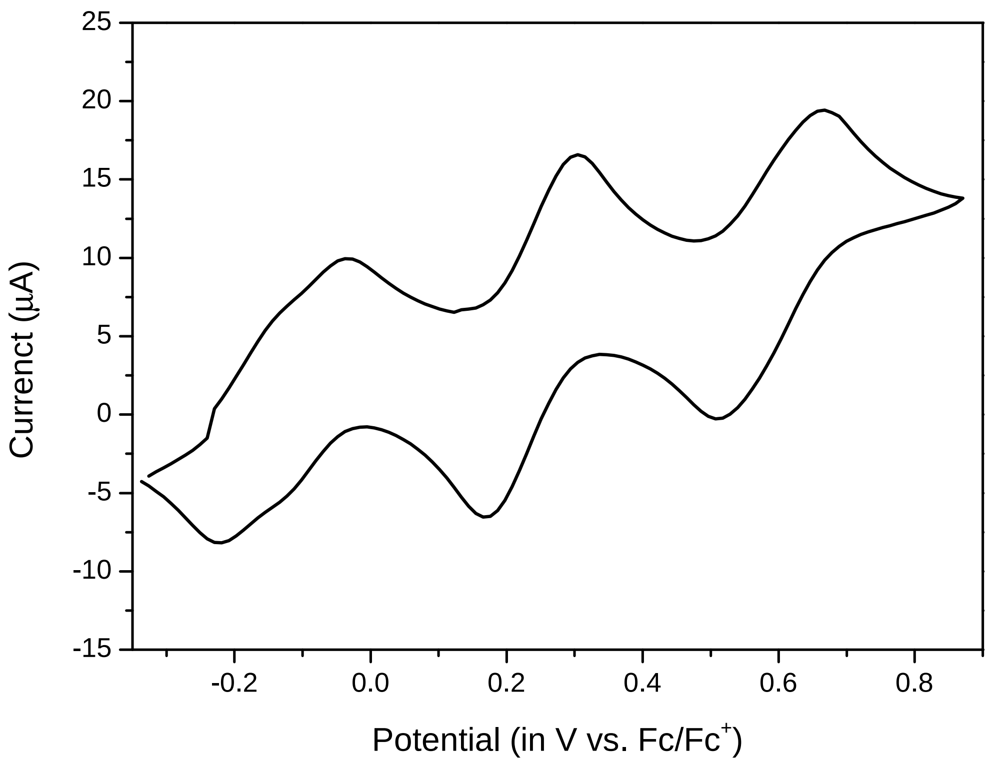

Figure S6: Cyclic voltammetry of dissolved HTM **1** 1.7×10^{-3} M in a solution of 0.1 M tetrabutylammonium hexafluorophosphate in dichloromethane. The scan rate was $100\,\mathrm{mVs^{-1}}$.

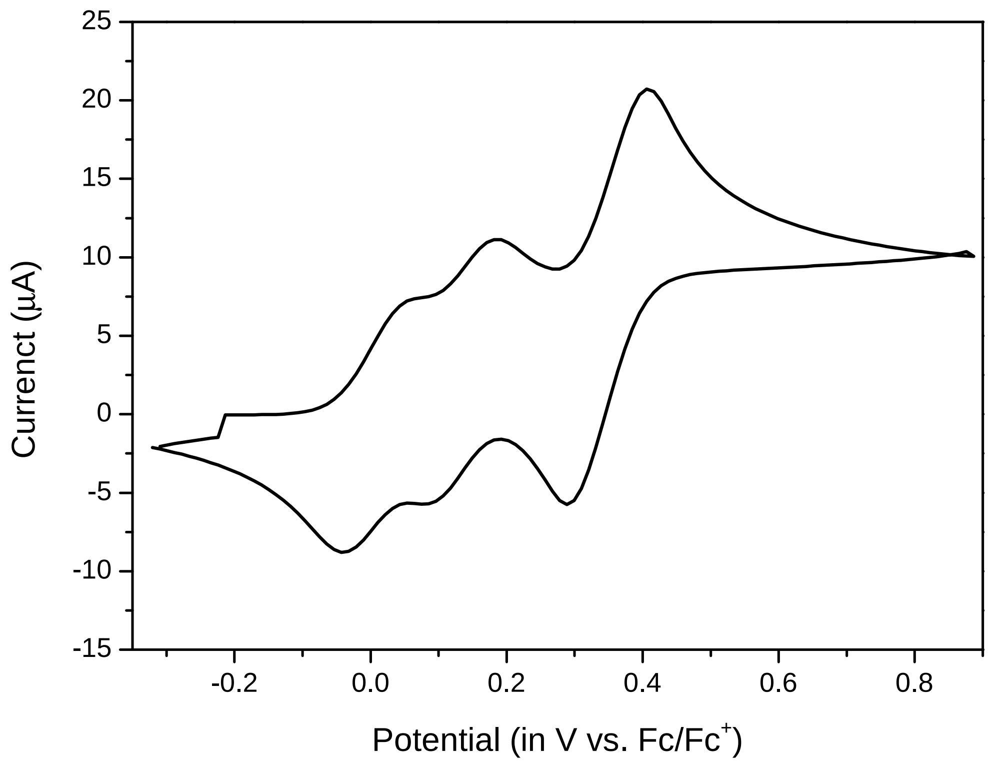

Figure S7: Cyclic voltammetry of dissolved spiro-OMeTAD 1.7×10^{-3} M in a solution of 0.1 M tetrabutylammonium hexafluorophosphate in dichloromethane. The scan rate was $100\,\mathrm{mVs^{-1}}$.

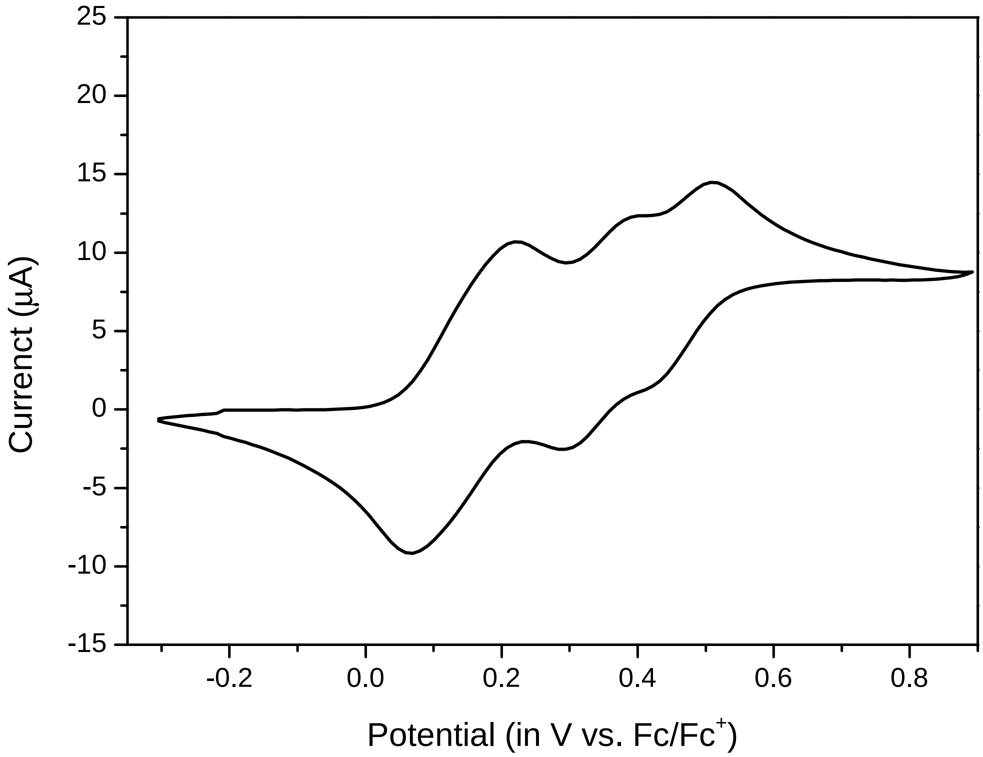

Figure S8: Cyclic voltammetry of dissolved HTM **2** 1.8×10^{-3} M in a solution of 0.1 M tetrabutylammonium hexafluorophosphate in dichloromethane. The scan rate was $100\,\mathrm{mVs}^{-1}$.

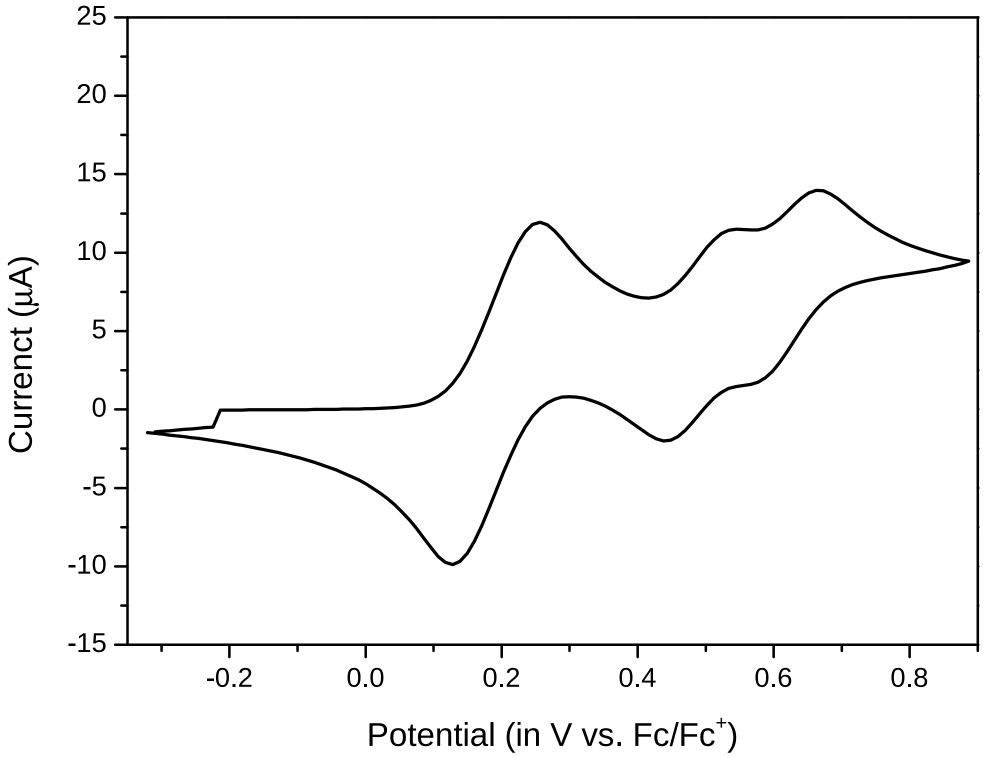

Figure S9: Cyclic voltammetry of dissolved HTM **3** 1.5×10^{-3} M in a solution of 0.1 M tetrabutylammonium hexafluorophosphate in dichloromethane. The scan rate was $100\,\mathrm{mVs^{-1}}$.

Charge-Collection Efficiency

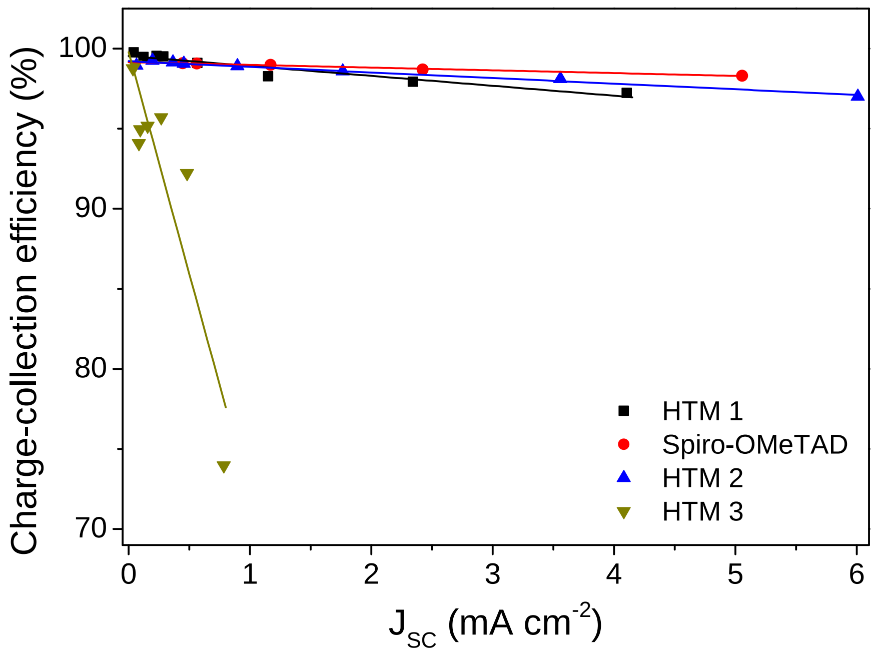

Figure S10: Charge-collection efficiency of each HTM for different short-circuit currents. The solid lines are a linear fit to the data.

Capacitance Measurements

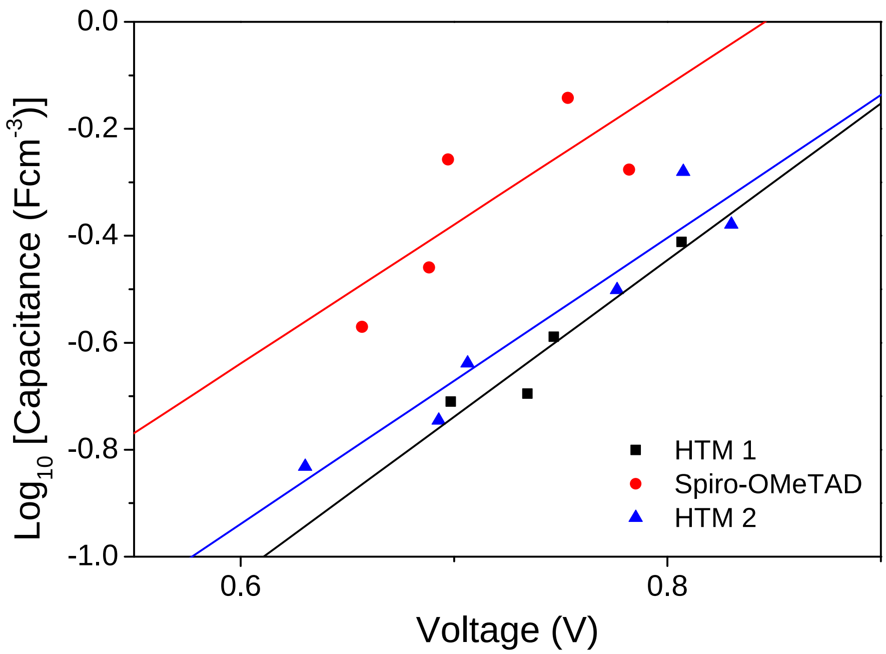

Figure S11: Capacitance measurements for HTM1, spiro-OMeTAD and HTM2. The solid lines are an exponential fit to the capacitance.