Supporting Information

Changes from Bulk to Surface Recombination Mechanisms Between Pristine and Cycled Perovskite Solar Cells

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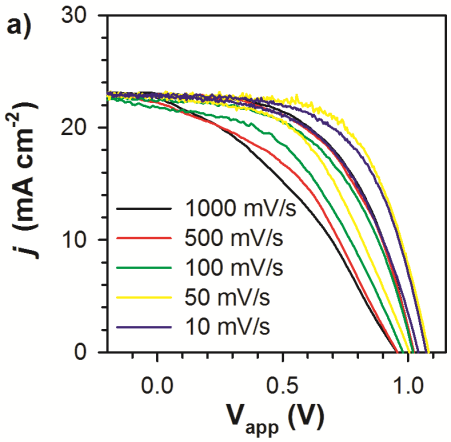

Figure SI1: *j-V* measurements carried out at 1 sun light illumination as a function of the scan rate. Hysteresis is minimized as the scan rate is reduced.

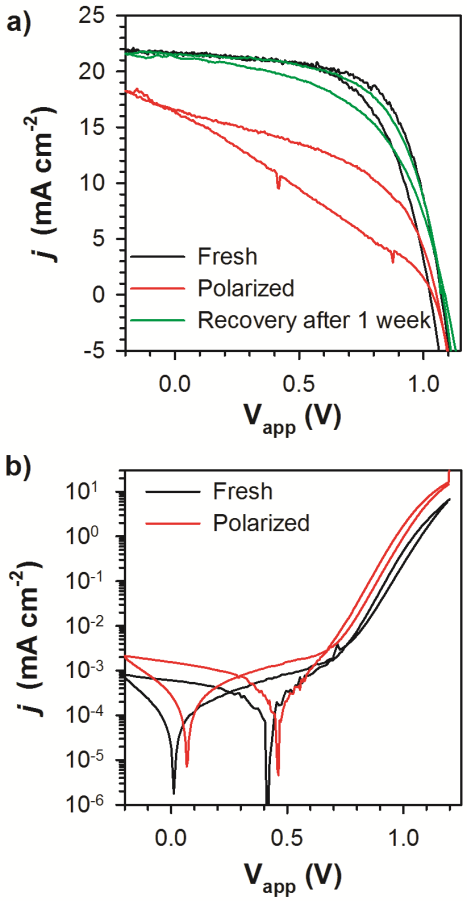

Figure SI2: a) *j-V* of a representative device prepared in the same batch that shows less hysteresis at sweep rate of 50 mV/s but similar response after polarization of the device by illumination at 1 sun at 1.2 V for 10 min. Efficiency is partially recovered after storing the device in dry oxygen in the dark. b) Comparison of *j-V* curve of fresh and polarized devices measured in the dark.

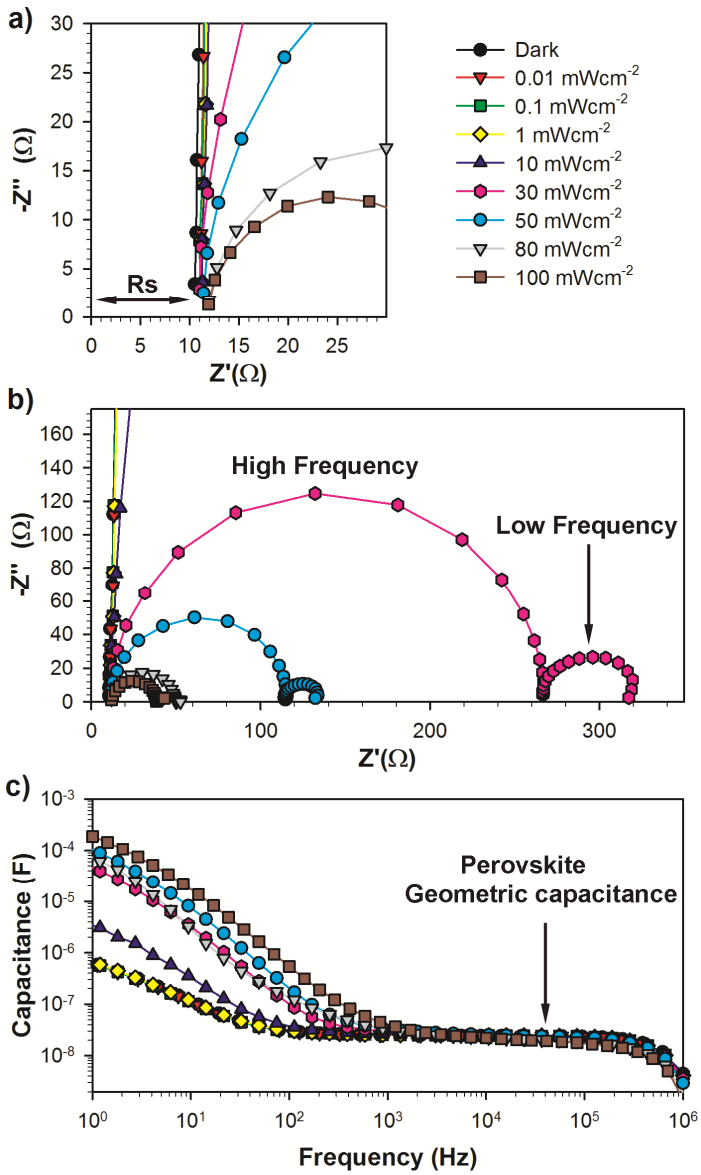

Figure SI3: Summary of impedance spectroscopy data for measurements carried out at V_{oc} conditions under different light intensities. a) Analysis of series resistance by using the complex impedance plot. The R_s remains almost constant during the measurement. b) Complex impedance plot highlighting measurements at high light intensity conditions relevant for the analysis described in the main text. Two arcs are observed as described previously in the literature c) Capacitance-frequency plot. The plateau measured at high frequencies corresponds to the bulk properties of the perovskite layer as described in the literature.[1]

References

1. Guerrero, A.; Garcia-Belmonte, G.; Mora-Sero, I.; Bisquert, J.; Kang, Y. S.; Jacobsson, T. J.; Correa-Baena, J.-P.; Hagfeldt, A. Properties of Contact and Bulk Impedances in Hybrid Lead Halide Perovskite Solar Cells Including Inductive Loop Elements. *The Journal of Physical Chemistry C* **2016,** *120* (15), 8023-8032.