Voltage-Dependent Photoluminescence Quantum Yield in Perovskite Solar Cells

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Introduction

The loss mechanisms in perovskite solar are still not fully understood. We offer a new tool to investigate non-radiative recombination mechanisms.

Results

- $J_{gen} < J_{max}$: Current loss due to reflection and parasitic absorption.
- $J_{SC} < J_{gen}$: Current loss due to recombination even at SC conditions. This shows that even at external V = 0, internally there is QFLS ≠ 0. This explains why the PL at SC is not fully quenched. The origin is either a low mobility or charge barriers.
- The PLQY is at OC the highest. This can give further information about the non-radiative recombination mechanisms.

Additional information

Radiative and non-Radiative Losses by Voltage-dependent In-situ Photoluminescence in Perovskite Solar Cell Current-Voltage Curves
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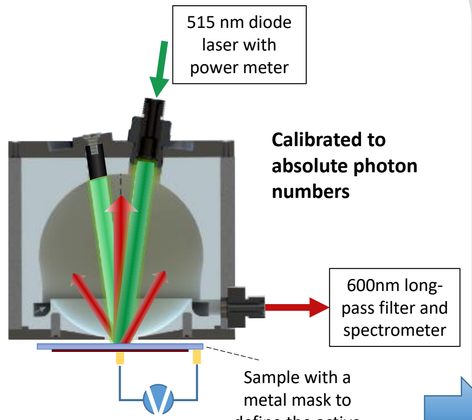
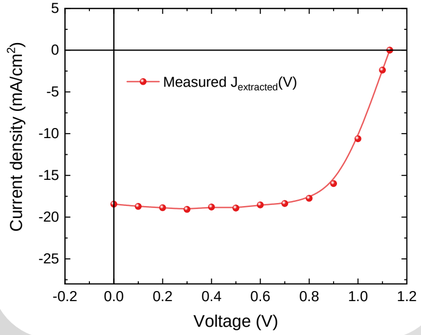
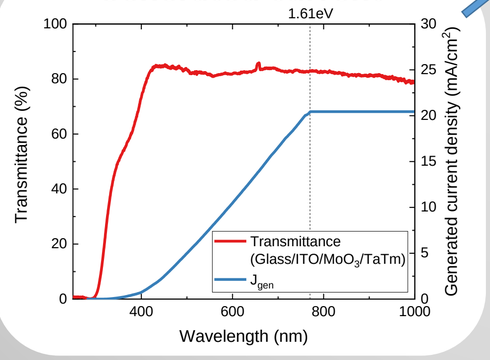
Measurement Set-up



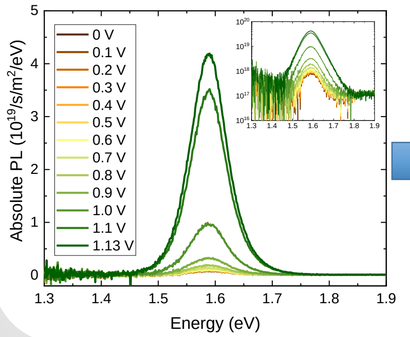
Electrical current

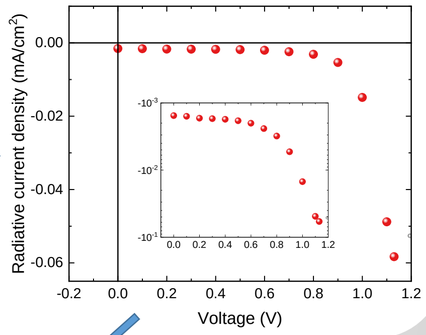


Generated current

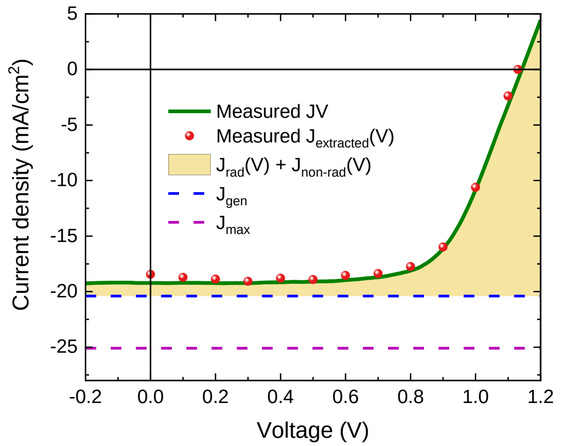


Radiative current

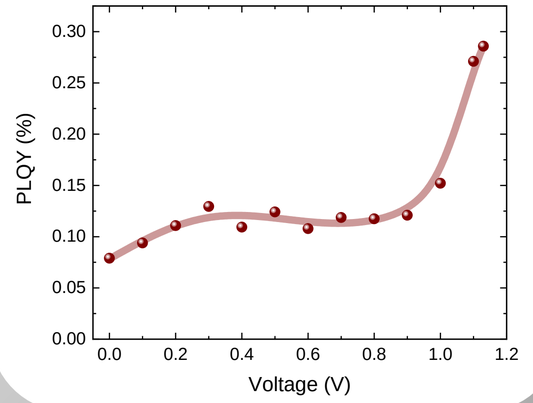




$$J_{gen} = J_{extracted}(V) + J_{rad}(V) + J_{non-rad}(V)$$



Voltage-dependent PLQY



Methods

We measure simultaneously the extracted electrical current as well as the radiative current via a calibrated photoluminescence (PL) measurement exciting with a laser at 1 sun equivalent. Additionally, the generated charge current is estimated with help of the transmittance of the top layers. Therefore, we can extract the voltage-dependent non-radiative recombination and the PL quantum yield (PLQY).

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