

Advancing Optoelectronics: A Comparative Study on the Characterization of Perovskite Solar Cell Absorber Material with and without 2D Surface Passivation Layer Using TRMC Technique

**Arpana Singh^{1,*}, Biruk Alebachew Seid², Felix Lang², Hafiz Sami ur Rehman¹,
Marinus Kunst³, Heinz-Christoph Neitzert¹**

¹DIIN, Salerno University, 84084 Fisciano, Italy

²ROSI Freigeist Group, Institut für Physik und Astronomie, Universität Potsdam, Potsdam Golm, Germany

³Helmholtz-Zentrum Berlin, 14109 Berlin, Germany

Email address:

asingh@unisa.it (Arpana Singh), biruk1660@gmail.com (Biruk Alebachew Seid), lang1@uni-potsdam.de (Felix Lang),
hsamiurrehman@unisa.it (Hafiz Sami ur Rehman), kunstm@orange.fr (Marinus Kunst),
neitzert@unisa.it (Heinz-Christoph Neitzert)

*Corresponding author

Abstract

The application of Time Resolved Microwave Conductivity (TRMC) as a non-contact method for assessing charge carrier kinetics in photoconductive materials has proven successful in recent studies focused on perovskite thin films. The excess charge carrier lifetimes have been measured under various conditions regarding light intensity, pulse length and excitation laser wavelength. This study demonstrates the informative value derived from TRMC measurements conducted at low laser intensities and diverse wavelengths for the evaluation of the quality of perovskite films with triple cation and triple anion compositions, using PEAI layers for surface passivation in certain cases. A strong correlation has been found between the observed changes in excess charge carrier lifetime within the absorber films and the subsequent performance of the solar cells constructed with these layers. The non-passivated sample exhibits an accelerated decay rate in comparison to its passivated counterpart in the microsecond range. Additionally, there is a significant reduction in the TRMC-amplitude in the non-passivated films relative to the passivated ones, indicating fast recombination already during the excitation.

Keywords

Perovskite Solar Cell, TRMC, Charge Carrier Life-time, Passivation