**The impact of SRH recombination on the current-voltage characteristic of organic and perovskite solar cells**

N. Arbutina, J. Gojanović, P. Matavulj

*School of Electrical Engineering,*

*University of Belgrade, Serbia*

email: an243193m@student.etf.bg.ac.rs

Nowadays, extremely important emerging technologies of solar cells are organic (OSC) and perovskite solar cells (PSC). Being cheap, lightweight, flexible, scalable and with good efficiency these solar cells are subject of further development, especially investigation of physical processes undergoing the solar cells operation, because of need for reaching their full potential. It is especially important to understand the influence of recombination as it is fundamental mechanism of losses both in OSCs and in PSCs.

In this paper we have used one dimensional drift-diffusion model for describing processes inside of the OSCs and PSCs, such as generation, transport and recombination of carriers [1]. Generation was calculated using transfer matrix method. We have assumed constant values for electron and hole mobility. For solving the drift-diffusion equations Dirichlet boundary conditions were applied. We used Shockley-Read-Hall (SRH) and Langevin recombination, where recombination rate was controlled by introducing variable coefficients: $K\_{L}$ and $K\_{SRH}$, where the first correspond to change in reduction coefficient of Langevin recombination and the second correspond to change in trap states concentration ($N\_{t}$). Drift-diffusion equations are then solved numerically. Discretization of equations was done using finite difference method with Scharfetter-Gummel approach. System of discretized equations was solved using Newton method [2].

Changes in the current density-voltage (J-V) characteristic of OSCs and PSCs with the change of $K\_{L}$ and $K\_{SRH}$ were analyzed. Changes in open-circuit voltage ($V\_{OC}$), short-circuit current ($J\_{SC}$), fill factor ($FF$) and power conversion efficiency (PCE) were observed and monitored. Our analysis has concluded that Langevin recombination has strong influence on OSCs performance, while its influence on PSCs is negligible. Increase in SRH recombination rate has negative impact on both OSC and PSC, whereat in OSCs its dominant impact is on declining $J\_{SC}$, while in PSCs the $V\_{OC}$ is dominantly decreased. This indicates different operating mechanisms between OSCs and PSCs. In the case of OSCs stronger influence of SRH recombination begins with $N\_{t}=10^{15}cm^{-3}$ and total degradation of the device starts at $N\_{t}=2∙10^{17}cm^{-3}$, while in the case of PSCs stronger influence of SRH recombination begins at $N\_{t}=10^{17}cm^{-3}$ and total degradation of the device starts at $N\_{t}=10^{19}cm^{-3}$. The model was validated by successfully reproducing a PSCs J-V curve taken from the literature.

ACKNOWLEDGEMENT: This work was financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia under contract number: 451-03-137/2025-03/200103.

REFERENCES:

[1] D. Li, L. Song, et al, Adv. Sci. 7, (2019)

[2] A. Khalf, J. Gojanović, N. Ćirović, et al, IEEE J. Photovol. 10, 514, (2020)