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DEEP-LEARNING APPROACH TO THE IRON CONCENTRATION EVALUATION IN SILICON SOLAR CELL

Olikh Oleg
Taras Shevchenko National University of Kyiv, Kyiv, Ukraine, olegolikh@knu.ua, ORCID: 0000-0003-0633-5429

Lozitsky Oleg
Taras Shevchenko National University of Kyiv, Kyiv, Ukraine, olozitsky@gmail.com, ORCID: 0000-0002-6872-6655

Zavhorodnii Oleksii
Taras Shevchenko National University of Kyiv, Kyiv, Ukraine, nevermor464@gmail.com, ORCID: 0000-0001-8080-766

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Abstract: Impurities are crucial for solar cell (SC) performance. The aim of our work is to show the possibility of fast and easy evaluation of iron concentration in silicon SC by using current-voltage characteristics (IVC). For this purpose, SCAPS was used to simulate the IVCs for n^+-p-p^+-Si structures with various both base thickness (150-240 μm) and boron doping level (10^{15}-10^{17} cm^{-3}) in range 290-340 K. The recombination was considered to be associated with iron atoms with concentration 10^{10}-10^{13} cm^{-3} and two cases (the coexistence of interstitial atoms Fe_i and pairs Fe_iB_s as well as the presence of Fe_i only) were under investigation. The IVC ideality factors were calculated in these cases ($n_{Fe\text{-}FeB}$ and n_{Fe} respectively). n values and SC parameters for more than 10,000 structures were used for neural network learning. Keras was used to construct the network with up to 4 hidden dense layers (up to 300 neuron, relu activation) and iron concentration as output. It was shown that mean squared relative error for test data prediction was up to 0.28 in case of network, which trained by $n_{Fe\text{-}FeB}$ value and up to 0.06 in case of both $n_{Fe\text{-}FeB}$ and n_{Fe} using. The work was supported by NRFU (project 2020.02/0036).

Keywords: *Silicon solar cell, iron concentration, neural network, ideality factor*