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A NEW APPROACH FOR THE PHYSICAL INTERPRETATION OF TEMPERATURE DEPENDENT EBIC CONTRAST MEASUREMENTS

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During the last decade several attempts have been made to obtain spectral information about defect levels in silicon with temperature dependent EBIC measurements, but no generally accepted model for the interpretation of the results has emerged. Some of the models even come to contradictory results [1,2].

We will present a new model, which is based on the application of recombination statistics (Shockley-Read-Hall) to the localized defect levels in the bandgap of the semiconductor. The temperature dependence of the thermal velocity of the charge carriers (\(\propto \sqrt{T}\)) on the one hand, and the influence of the defect level and the Fermi energy position on the other hand lead to a maximum in the recombination rate via this level, if the recombination rate is analyzed as a function of the sample temperature. The EBIC contrast, which is a direct measurement of the recombination activity, reflects this dependence, if the geometrical contributions to the contrast (i.e. mainly the diffusion length \(L\) of the minority carriers) are assumed to be constant throughout the measured temperature range.

A re-interpretation of experimental results on dislocations obtained by Ourmazd [1] and Wilshaw and Booker [2] shows the applicability of this model. A common feature of many experiments, as observed by Jakubowicz et. al. [3], finds a simple explanation as well as differences between measurements of Kimerling et. al. and own measurements on individual stacking faults.

We will also present measurements of defects related to substitutional gold in silicon, which exhibits the double peak structure expected for two levels in the bandgap. The temperature, where the peaks appear can be analyzed and yields the two main levels of substitutional gold.

(1) A. Ourmazd: Cryst. Res. Tech. 16, 137 - 146