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RECOMBINATION AT DISLOCATION LEVELS LOCATED IN THE SPACE CHARGE REGION.
EBIC CONTRAST EXPERIMENTS AND THEORY

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Recombination at dislocations located in the space charge region (SCR) of a Schottky diode has been previously evidenced by EBIC contrast experiments [1] in the case of non intentionally n type CdTe. A depth-dependent recombination probability was, then, phenomenologically ascribed to the dislocation, in order to fit theoretical EBIC curves as a function of the beam accelerating voltage $E_0$ obtained for dislocations perpendicular to the surface, with experimental ones. A variable radius $\varepsilon(z)$ was assigned to the recombination cylinder which described the dislocation and within which the recombination efficiency was taken equal to 100% [2].

We propose a physical model associated with intrinsic dislocation properties to describe the origin of such EBIC contrast. Indeed, owing to the $z$ dependent screening properties within the depleted region, the dislocation trapped carrier density is $z$ dependent and is responsible for the existence of a depth dependent electrical field. This field partly counterbalances the own electrical field of the Schottky diode. The $z$ dependent radius $\varepsilon(z)$ is finally estimated as being to the distance from the dislocation line at which the dislocation electric field is equal to that of the Schottky diode.

The minority carrier self consistently captured by the dislocation exactly counterbalances the electron flux which may either come from thermal activation up to the top of the dislocation barrier and/or by an electron current flowing along the dislocation line itself. Thus, owing to the majority carrier trapping possibilities, a saturation effect may occur and modify the capture cylinder $\varepsilon(z)$, which would, therefore, depend on the minority carrier injection dose.

Within the SCR, dislocation fields may only be calculated by using either the Debye-Hückel rough approximation or by directly numerically solving Poisson's equation. Both methods are presented and obviously demonstrate that, in the ideal case where the saturation effect is neglected, the $\varepsilon(z)$ radius obtained in such calculations leads to a good quantitative agreement between theoretical and experimental EBIC curves; these have been obtained by varying both $E_0$ and the reverse bias of the Schottky diode.

However, if the majority carriers involved in this process are only the thermally activated electrons at the dislocation barrier top, the capture radius obtained previously would lead to a noticeable saturation effect except if the capture coefficients are, at least, as large as $\approx 10^{-13}$ cm$^2$. Thus, in the present case of CdTe, it could be concluded that either electron capture coefficients are large and/or a majority carrier current may occur along the dislocation line.