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On polarization in compensated semiconductors

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It is well known that in some detectors the performances deteriorate with the operation time or increasing flux (e.g. CdTe and CdZnTe detectors). This phenomenon is often described by the general term “polarization”. The exact mechanism is usually unclear, but it is generally agreed that the effects are caused by a buildup of a space charge in the device. Such space charge decreases the electric field causing a decrease in charge collection efficiency. It may also increase the charge collection time which requires longer shaping times in the electronic circuitry, leading to increased electronic noise (mainly 1/f).
The nature of the space charge and the formation mechanisms remain vague. It is well documented that the effect is influenced by the semiconductor properties as well as by contacts. Namely, the polarization can be very pronounced with one metallization, and practically disappear with another (for the same semiconductor sample).
In this study finite element calculations were used to assess the impact of imperfect ohmic contacts, and compensating trap properties on the space charge formation and on the macroscopic device behavior. It is shown that low recombination velocity of otherwise ohmic contacts leads to a formation of space charge inside the device, but the space charge density is insufficient to affect the electric field distribution significantly without the presence of compensating levels.

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