Influence of charged oxide layers on TEM imaging of reverse-biased p-n junctions

Experimental observations of reverse-biased p-n junctions by means of the out-of-focus method display features which cannot be interpreted within the standard theory of an abrupt p-n junction. In order to reconcile theory and experiment it is necessary to introduce an active role of the specimen surfaces. In particular it is shown how the introduction of a suitable surface density charge at the interface between the silicon and oxide created after the thinning process allows us to explain the main features of the experimental results. Moreover, some questions left unanswered by previous observations made by Lorentz and holographic methods will be clarified. The results point out that oxide charging cannot be overlooked and should be properly taken into account whenever semiconductor devices are observed by transmission electron microscopy techniques, especially when these methods are employed for the analysis of dopant diffusion in submicron devices.

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