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Determination of the p-n Junction Built-in Voltage using Quantitative Dopant Mapping in the FEG-SEM PAYAM KAZEMIAN, COLIN J. HUMPHREYS, University of Cambridge, SJOERD A.M. MENTINK, Philips Research The Netherlands — Two-dimensional dopant mapping with nanometre-scale spatial resolution is possible in semiconductors using secondary electron (SE) imaging in a Field Emission Gun Scanning Electron Microscope (FEG-SEM). However, existing methods are only qualitative. Here, a quantitative SEM method for measuring dopant concentrations and the built-in voltage across a p-n junction is given. The energy spectrum of SEs emitted from the p-doped side of a p-n junction is shifted in energy with respect to SEs emitted from the n-doped side by eV_b, where V_b is the built-in voltage across the junction. We have measured this energy shift using a FEI XL30s FEG-SEM equipped with a through-the-lens (TTL) SE detector. It is possible to set up an adjustable energy window in this microscope by using the extractor tube potential and the deflector voltage in the TTL detector as the lower and upper edges of the energy window. By varying these voltages, the FEG-SEM can be used to analyse the energies of the secondary electrons emitted from the specimen, and the energy shift between the SEs emitted from the p and n sides of a p-n junction can therefore be measured. This energy shift, essentially eV_b, across a p-n junction can therefore be obtained using SE imaging in a FEG-SEM, which enables two-dimensional quantitative dopant profiling to be rapidly performed.

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