The widely used photovoltaic (PV) systems are based on p-type silicon solar cells (SSC). Iron for such structures is an omnipresent and efficiency-limiting impurity. Therefore, iron detection and estimation are essential tasks. The conventional techniques are time-consuming and require special equipment. Simultaneously iron is easily transformed between two metastable states, and such a transition affects SSC parameters, which are simple detected from current-voltage characteristics (IVC). We aimed to verify the ability to use iron-induced PV parameters change for impurity evaluation in finished SSC.

The simulation of silicon n+-p-p+ structures was performed using SCAPS-1D software. The simulation of light IVC (AM1.5 illumination conditions or monochromatic light 940 nm, 4 W) were carried out over the temperature range 290-340 K. The changes of short-circuit current (Isc), open-circuit voltage (Voc), efficiency (η), and fill factor (*FF*) were under consideration for SSC with various base depth (180-380 μm), base dopant concentration NA (boron, 1015-1017 cm-3), and iron concentration NFe (1010-1014 cm-3). It was shown that Isc and η are most promising for iron evaluation because their relative changes rich up to 40-50% and monotonically depend on NFe; the change in Voc is about 10%, but umbios relationship between εVoc and NFe is observed at low and middle boron concentration; *FF* change is less 1% only at NA=1017 cm-3 and non-monotonically depend on NFe concentration at low boron concentration.

Evaluation of iron contamination in silicon solar cells via photovoltaic parameters

The installed photovoltaic (PV) systems are mainly based on p-type silicon solar cells (SSC), where iron is an omnipresent and efficiency-limiting impurity. Therefore, iron detection is an essential task. Conventional techniques require special equipment. Simultaneously iron is easily transformed between two metastable states, and such a transition affects SSC parameters, which are simply detected from current-voltage characteristics. We aimed to consider iron-induced PV parameter changes for impurity evaluation in SSC.

The SSC simulation was performed using SCAPS-1D software for a temperature range of 290-340 K. The AM1.5 or monochromatic light (940 nm) illumination conditions were used. The relative changes of short-circuit current (Isc), open-circuit voltage (Voc), efficiency (η), and fill factor (FF) were under consideration for SSC with various base depth (180-380 μm), dopant concentration NA (boron, 1015-1017 cm-3), and iron concentration NFe (1010-1014 cm-3). It was shown that Isc and η are most promising for iron evaluation because their changes rich up to 40-50% and monotonically depend on NFe; the change in Voc is about 10%, but an ambiguous relationship between εVoc and NFe is observed at low boron concentration; FF change is less 1% only at NA=1017 cm-3 and non-monotonically depend on NFe is foreseen as well.