**Iron's impact on silicon solar cell execution: comprehensive modeling across diverse scenarios**

Oleg Olikh, Oleksii Zavhorodnii

*Taras Shevchenko National University of Kyiv, 64/13, Volodymyrska Street, Kyiv, 01601, Ukraine*

olegolikh@knu.ua

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| Fig.S1. Relative changes in short-circuit current caused by a complete dissociation of FeiBs pairs as a function of iron concentration and doping level for SC with different base depth. *T*, K: 290 (left panels), 340 (right panels). | |

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| Fig.S2. Relative changes in short-circuit current caused by a complete dissociation of FeiBs pairs as a function of iron concentration and doping level at different temperatures. *dp*, μm: 180 (left panels), 380 (right panels). | |

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| Fig.S3 Relative changes in short-circuit current caused by a complete dissociation of FeiBs pairs as a function of iron concentration and temperature for SC with different base depth. *N*B, cm-3: 1015 (left panels), 1016 (middle panels), 1017 (right panels). | | |

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| Fig.S4. Relative changes in short-circuit current caused by a complete dissociation of FeiBs pairs as a function of iron concentration and temperature for SC with different base doping level. *dp*, μm: 180 (left panels), 380 (right panels). | |

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| Fig.S5. Relative changes in short-circuit current caused by a complete dissociation of FeiBs pairs as a function of iron concentration and base depth for different temperatures. *N*B, cm-3: 1015 (left panels), 1016 (middle panels), 1017 (right panels). | | |

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| Fig.S6. Relative changes in short-circuit current caused by a complete dissociation of FeiBs pairs as a function of iron concentration and base depth for SC with different base doping level. *T*, K: 290 (left panels), 340 (right panels). | |

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| Fig.S7. Relative changes in open-circuit voltage caused by a complete dissociation of FeiBs pairs as a function of iron concentration and doping level for SC with different base depth. *T*, K: 290 (left panels), 340 (right panels). | |

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| Fig.S8. Relative changes in open-circuit voltage caused by a complete dissociation of FeiBs pairs as a function of iron concentration and doping level at different temperatures. *dp*, μm: 180 (left panels), 380 (right panels). | |

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| Fig.S9. Relative changes in open-circuit voltage caused by a complete dissociation of FeiBs pairs as a function of iron concentration and temperature for SC with different base depth. *N*B, cm-3: 1015 (left panels), 1016 (middle panels), 1017 (right panels). | | |

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| Fig.S10. Relative changes in open-circuit voltage caused by a complete dissociation of FeiBs pairs as a function of iron concentration and temperature for SC with different base doping level. *dp*, μm: 180 (left panels), 380 (right panels). | |

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| Fig.S11. Relative changes in open-circuit voltage caused by a complete dissociation of FeiBs pairs as a function of iron concentration and base depth for different temperatures. *N*B, cm-3: 1015 (left panels), 1016 (middle panels), 1017 (right panels). | | |

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| Fig.S12. Relative changes in open-circuit voltage caused by a complete dissociation of FeiBs pairs as a function of iron concentration and base depth for SC with different base doping level. *T*, K: 290 (left panels), 340 (right panels). | |

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| Fig.S13. Relative changes fill factor caused by a complete dissociation of FeiBs pairs as a function of iron concentration and doping level for SC with different base depth. *T*, K: 290 (left panels), 340 (right panels). | |

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| Fig.S14. Relative changes fill factor caused by a complete dissociation of FeiBs pairs as a function of iron concentration and doping level at different temperatures. *dp*, μm: 180 (left panels), 380 (right panels). | |

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| Fig.S15. Relative changes in fill factor caused by a complete dissociation of FeiBs pairs as a function of iron concentration and temperature for SC with different base doping level. *dp*, μm: 180 (left panels), 380 (right panels). | |

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| Fig.S16. Relative changes in fill factor caused by a complete dissociation of FeiBs pairs as a function of iron concentration and base depth for SC with different base doping level. *T*, K: 290 (left panels), 340 (right panels). | |

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| Fig.S17. Relative changes efficiency caused by a complete dissociation of FeiBs pairs as a function of iron concentration and doping level for SC with different base depth. *T*, K: 290 (left panels), 340 (right panels). | |

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| Fig.S18. Relative changes efficiency caused by a complete dissociation of FeiBs pairs as a function of iron concentration and doping level at different temperatures. *dp*, μm: 180 (left panels), 380 (right panels). | |

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| Fig.S19. Relative changes in efficiency caused by a complete dissociation of FeiBs pairs as a function of iron concentration and temperature for SC with different base doping level. *dp*, μm: 180 (left panels), 380 (right panels). | |

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| Fig.S20. Relative changes in efficiency caused by a complete dissociation of FeiBs pairs as a function of iron concentration and base depth for SC with different base doping level. *T*, K: 290 (left panels), 340 (right panels). | |