The Solar Energy Research Institute of Singapore (SERIS) is developing a web-based solar cell simulation platform called “XSolar-Hetero”, enabling to dynamically upload various device/process/yield simulation programs for various solar cell architectures. It will provide a common online calculation capability to run existing solar cell simulation programs in zero, one and two dimensions (deploying established programs like PC1D, Quokka, Griddler or even Sentaurus TCAD, or executing self-written programs in Mathematica, MatLab or Excel) and allow users to modify/save individual parameters in a personalized user database.

This contribution gives an update on the current status of the XSolar-Hetero simulation platform, by highlighting several developed simulation capabilities supporting the optimization of a boron tube diffusion process. Using process simulation (Sentaurus TCAD), the boron diffusion profile can be predicted as a function of temperature and duration of the BBr₃ diffusion process, the drive-in process and the post-oxidation process [1]. Using carrier lifetime simulations (PC1D), the intensity dependent lifetime of symmetrically passivated test samples using this diffusion profile can be predicted. Using 2D device simulation (Quokka), the corresponding solar cell efficiency can be predicted for the case of using this diffusion profile in a bifacial nFAB (n-type front and back contacted) solar cell structure. By uploading experimental data files obtained from electrochemical capacitance voltage profiling (diffusion profile screening, ECV) and quasi-steady-state photoconductance measurements (Sinton lifetime testing, QSSPC), the process and lifetime simulations can be directly calibrated to the corresponding measurements.

Figure 1: Sketch of the present web based solar cell simulation platform “XSolar-Hetero”, a user-centric database, connecting a solar cell architecture (of a solar cell / a solar cell pre-cursor / a test-sample) to real and/or simulated measurements, highlighting its main feature, i.e. (1) Choosing (or adding) various solar cell architectures, (2) Choosing (or adding) various solar cell simulation programs, which basically simulate measurements from a given (dynamic) set of input parameters, (3) Uploading real measurement data, (4) Managing user and access control.

Figure 2: (Left) A schematic illustration of the time-temperature profile of a typical industrial BBr₃ diffusion process including a BSG deposition, a drive-in and a post-oxidation step. The temperature and the process time of these process steps have a significant influence on the resulting boron diffusion profile. (Middle) Process simulated boron diffusion profiles with ±5% and ±10% variation on the post-oxidation temperature. (Right) Measured boron diffusion profiles (by electrochemical capacitance voltage profiling, ECV), showing the influence of the post-oxidation step. Data taken from our recent publication [1].