

The Mechanism of Enhanced Diffusion of Phosphorus in Silicon During Rapid Photothermal Processing of Solar Cells

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Abstract

In this paper, we have presented the experimental results of phosphorus diffusion in silicon for the cases of rapid thermal processing (RTP) and rapid photothermal processing (RPP). In the case of the RPP, other than thermal energy, the vacuum ultraviolet photons are used as an additional source of energy. We have investigated the secondary-ion-mass-spectroscopy impurity profiles at different concentrations of P in Si. Based on our own experimental results and the data published in the open literature, we have provided an explanation of the enhanced diffusion both for the RTP and RPP cases. The thermal factor leads to the excitation (vibration) of atoms and quantum energy to the electron system excitation. As compared with the pure thermal process, the quantum-energy contribution provides a reduced activation energy and a higher diffusion coefficient.