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Towards Efficient Solar Cells: Optimizing Non-Equilibrium Hyperdoping Methods TOBIAS M. SCHNEIDER, MICHAEL P. BRENNER, Harvard School of Engineering and Applied Sciences — Electrical and optical properties of semiconductors are mainly controlled by the concentration of dopants. While the highest dopant concentrations reachable in most traditional doping methods are limited by the equilibrium solubility of the dopant in the pure semiconductor material, much higher concentrations are observed after femtosecond laser treatment of silicon in a sulfur containing atmosphere. Due to altered optical properties *laser-hyperdoped* silicon is considered a promising material for next generation photovoltaic cells. To control the dopant concentration distribution and thereby tune physical properties of the material, we apply advanced adjoint based optimization techniques to the models describing the laser induced melting and diffusion processes. This allows to determine optimal process protocols generating a desired concentration distribution. Applying advanced PDE-contrained optimization techniques to laser hyperdoping thereby opens new avenues for improving the efficiency of photovoltaic cells.

Tobias M Schneider
Harvard School of Engineering and Applied Sciences

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