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Carrier dynamics in sulfur-hyperdoped silicon studied by time-resolved terahertz spectroscopy MENG-JU SHER, Stanford Institute for Materials and Energy Sciences, SLAC National Accelerator Laboratory, CHRISTIE SIMMONS, AUSTIN AKEY, MARK WINKLER, Massachusetts Institute of Technology, DANIEL RECHT, Harvard School of Engineering and Applied Sciences, TONIO BUONASSISI, Massachusetts Institute of Technology, MICHAEL AZIZ, Harvard School of Engineering and Applied Sciences, AARON LINDENBERG, Department of Materials Science and Engineering, Stanford University — Intermediate-band photovoltaics have been proposed to enhance efficiencies of solar cells by harvesting additional energy from sub-bandgap photons. One proposed method for fabricating an IB material is by introducing deep-level dopants at concentrations above the insulator-to-metal transition (IMT). Theory suggests that as the dopant states become delocalized, the non-radiative recombination is suppressed and the lifetime recovery enables photo-generated carriers to be harvested. We use optical-pump/terahertz-probe spectroscopy to study carrier dynamics of sulfur-hyperdoped silicon and test whether lifetime recovery is possible in this material system. S-hyperdoped silicon exhibits strong sub-bandgap light absorption and IMT at S concentration above 2×10^{20} cm^{-3}. Previous photoconductivity study suggests the lifetime is less than 130 ps for samples at concentrations below IMT. Time-resolved THz spectroscopy is suitable for studying carrier dynamics on short time scales. We use a 400-nm fs-laser pulse to generate carriers and by monitoring the transmission of the THz probe as a function of time, we extract the carrier dynamics and mobility all-optically.

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