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**Femtosecond-laser hyperdoping: controlling sulfur concentrations in silicon for band gap engineering** MENG-JU SHER, MARK WINKLER, YU-TING LIN, BENJAMIN FRANTA, ERIC MAZUR, Harvard University — Doping silicon to concentrations above the metal-insulator transition threshold yields a novel material that has potential for photovoltaic applications. By focusing femtosecond laser pulses on the surface of a silicon wafer in a sulfur hexafluoride (SF6) environment, silicon is doped with 1% atomic sulfur. This material exhibits near-unity, broadband absorption from the visible to the near infrared ($< 0.5$ eV, deep below the silicon band gap), and metallic-like conduction. These unusual optical and electronic properties suggest the formation of an intermediate band. We report on the femtosecond laser doping techniques we employ and the resulting material properties. By changing the laser parameters and ambient environment we can control the dopant profiles, crystallinity, and surface morphology. We perform optical absorption and temperature-dependent Hall measurements to investigate electron transport and to identify the energy states of the sulfur donors.

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