

## Optical Annealing of Black Silicon

Benjamin Franta, D. Pastor, M. Aziz, and E. Mazur

**Abstract** Silicon hyperdoped with chalcogens using femtosecond (fs) laser irradiation (“black silicon”) shows strong broad-band absorption due to intermediate band formation and surface texturing; thus, this material has promise for advanced optoelectronic devices such as silicon-based infrared photodetectors and intermediate band solar cells. To reduce structural defects and form a rectifying junction after fs laser irradiation, however, annealing is necessary, which deactivates the optical effect of the dopant. Here, we investigated the use of laser-based optical annealing using nanosecond (ns) excimer pulses and found that it removes amorphous material resulting from the black silicon fabrication process while maintaining high above-bandgap and sub-bandgap absorption. We also studied the effect of ns optical annealing on the surface morphology of black silicon.

---

B. Franta (✉) • D. Pastor • M. Aziz • E. Mazur  
School of Engineering and Applied Sciences, Harvard University, Cambridge, MA, USA  
e-mail: [bafranta@fas.harvard.edu](mailto:bafranta@fas.harvard.edu)