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Supersaturated Silicon-Chalcogen Alloys for Thin-film Photodetectors DANIEL RECHT, AURORE SAID, SI HUI PAN, MICHAEL AZIZ, Harvard School of Engineering and Applied Sciences, JEFFERY WARRENDER, US Army ARDEC - Benet Laboratories, THOMAS CRUSON, DAVID HUTCHINSON, PETER PERSANS, Rensselaer Polytechnic Institute, JOSEPH SULLIVAN, MARK WINKLER, TONIO BUONASSISI, Massachusetts Institute of Technology — Supersatured silicon-chalcogen alloys are known to have strong infrared optical absorption and the ability to detect light with energy less than silicon's bandgap. The range of infrared wavelengths these alloys absorb is much broader than the range over which photodiodes made from these alloys respond. We have recently performed several experiments to understand the disconnect between optical absorption and photodetection in thin, monocrystalline films of these alloys fabricated by ion implantation followed by nanosecond laser melting. When subjected to sensitive tests of photoconductivity, these alloys show no optoelectronic response at several absorbed sub-bandgap wavelengths. Furthermore, measurements on photodiodes made from silicon chalcogen alloys suggest that these materials are in fact a potent low-voltage photodetection gain medium. These results, along with temperature dependent transport measurements and sensitive optical spectroscopy, indicate that the mechanism of sub-bandgap response could be substantially more complex than is commonly thought.

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