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Chalcogen dopants for infrared optoelectronic Si JEFFREY WARRENDER, US Army Benet Laboratories, BRION BOB, MICHAEL AZIZ, Harvard School of Engineering and Applied Sciences, SUPAKIT CHARNVANICHBORIKARN, JAMES WILLIAMS, Australian National University, MALEK TABBAL, American University of Beirut, ATSUSHI KOHNO, Fukuoka University — Doping Si with a chalcogen in excess of the solubility limit has been shown to result in subbandgap optical absorption and sensitive photodetection, suggesting potential for chalcogen-doped Si as an infrared optoelectronic material. We investigated optical absorption and photovoltaic energy conversion using S, Se, and Te as dopants. We achieved supersaturation of the chalcogen dopant by ion implantation followed by pulsed laser melting and rapid solidification. We observed broadband subbandgap absorption for all dopants over a wavelength range from 1 to 2.3 microns. The subbandgap absorption and photovoltaic response depended sensitively on the chalcogen dose, laser processing, and thermal annealing conditions. We correlate these observations with the corresponding influence of the processing conditions on the material's crystalline quality, chalcogen dopant depth profile, carrier concentration profile, and dopant activation. We found good agreement between the chalcogen depth profiles obtained from experiments and a 1-dimensional model for plane-front melting, solidification, liquid-phase diffusion, and kinetic solute trapping.

Jeffrey Warrender
US Army - Benet Labs

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