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Semiconductor-core optical fibers for terahertz waveguides
DEREK BAS, SCOTT CUSHING, JOSEPH ROWLEY, West Virginia University, JOHN BALLATO, Clemson University, ROBERT RICE, Dreamcatchers Consulting, ALAN BRISTOW, West Virginia University — Waveguiding of terahertz (THz) radiation is important for imaging and communications applications. Simulations have been performed based on a fiber optic geometric waveguide with a poly-crystalline silicon core and silica cladding [1]. High-resistivity silicon has a flat dispersion over a 0.1 – 3 THz range [2], making it viable for propagation of broadband picosecond pulses of THz radiation such as that produced by optical rectification [3]. Frequency-dependent mode indices are determined for 0.1 – 0.3 mm diameter cores. The normalized frequency parameter V is also determined and a 140 micron core is selected as the low edge of diameters that can support a THz pulse. Finite-difference time-domain simulations are performed in two-dimensions to extract the propagation dynamics and the integrated intensity, from which transverse mode profiles and absorption lengths are extracted. It is found that for this core diameter the mode partially propagates in the cladding, such that the overall absorbance is only slightly less than in bulk polycrystalline silicon. [1] J. Ballato, T. Hawkins, P. Foy, R. Stolen, B. Kokuoz, M. Ellison, C. McMillen, J. Reppert, A. M. Rao, M. Daw, S. R. Sharma, R. Shori, O. Stafsudd, R. R. Rice, and D. R. Powers, Opt. Express 16, 18675-18683 (2008) [2] D. Grischkowsky, Søren Keiding, Martin van Exter, Ch. Fattinger, J. Opt. Soc. Am. B 7, 2006 (1990) [3] J. D. Rowley, J. K. Pierce, A. T. Brant, L. E. Halliburton, N. C. Giles, P. G. Schunemann, A. D. Bristow, Opt. Lett. 37, 788 (2012)

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