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Numerical research of mid-infrared supercontinuum generation in ZBLAN fibers

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Supercontinuum (SC) sources in the Mid-Infrared (mid-IR) wavelength region of 2-5 μm have variety of attractive applications such as in basic science, environmental monitoring, biomedical and security. In this paper, a numerical research of mid-IR SC generation is carried out. Both the time-domain and frequency-domain models of generalized nonlinear Schrödinger equation (GNLSE) and their solving methods are introduced. The characteristics such as dispersion, loss, Raman response function and nonlinear coefficient of the ZBLAN fiber are researched and how to select the parameters of ZBLAN fiber is discussed. Mid-IR SC generations in the ZBLAN fiber with different pumping wavelengths and pulse widths are compared. For a typical ZBLAN (55.8%ZrF_4-14.4%BaF_2-5.8%LaF_3-3.8%AlF_3-20.2%NaF) fiber with a core/cladding diameter of 8/125 μm, and a core numerical aperture of NA=0.27. The calculated fiber zero dispersion wavelength (ZDW) is 1.49 μm and material ZDW is 1.62 μm. The nonlinear refractive index of ZBLAN is taken to be $2.1 \bullet 10^{-20} m^2/W$ in simulations, the fractional contribution of delayed Raman response is calculated to be f_R=0.062. The numerical results show that the power distribution in the longer wavelengths of the mid-IR SC can be improved by pumping a ZBLAN fiber with 2 μm pulses instead of 1.55 μm pulses and there will be a better extension result for the longer pulse width under the same peak power and pumping wavelength.

Recent Publications

1. Weiqiang Yang, Bin Zhang, Guanghui Xue, Ke Yin, and Jing Hou (2014) Thirteen watt all-fiber mid-infrared supercontinuum generation in a single mode ZBLAN fiber pumped by a 2 μm MOPA system. *Opt. Lett.;* 39(7): 1849-1852.
2. Weiqiang Yang, Ke Yin, Bin Zhang, Guanghui Xue, and Jing Hou (2014) Several hundred kHz repetition rate nanosecond pulses amplification in Er-Yb co-doped fiber amplifier. *Appl. Phys. B;* 116(1): 169-174.

Biography

Weiqiang Yang has received BS degree in Optical Information Science and Technology from Huazhong University of Science and Technology, Wuhan, China, in 2007 and MS and PhD degrees in Optical Engineering from National University of Defense Technology, Changsha, China, in 2009 and 2014, respectively. He is currently a Research Assistant in the College of Advanced Interdisciplinary Studies at the National University of Defense Technology. His current research interests include fiber laser/amplifier technology, infrared supercontinuum generation in soft-glass fibers and supercontinuum generation in photonic crystal fibers.

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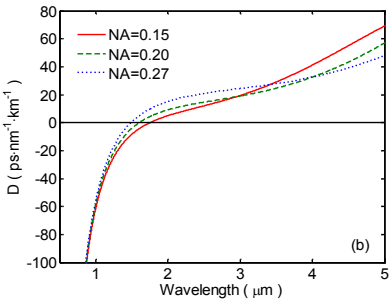


Figure-1: Calculated Zblan Fiber Dispersion Curves For Different Values Of Na With The Same Core Diameter Of 8 μm.

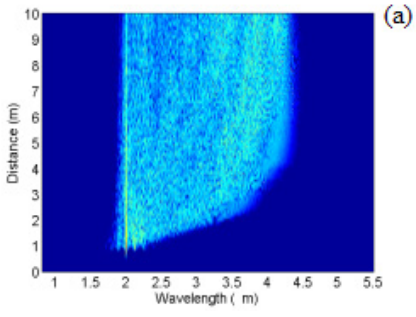
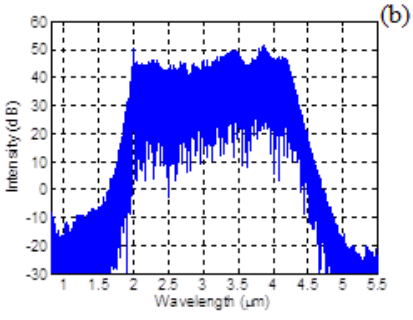


Figure-2: (a) Time domain delayed response . (b) Frequency response as a $\tilde{h}_R(\Omega)$ function of Stokes shift.



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