

Title: Fiber design and performance analyses for optical multiplexing: terahertz optical communications

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Abstract: Multiplexing is the process of combining multiple signals at a single channel. Orbital Angular Momentum (OAM) is one of the main multiplexing techniques for optical data transmissions. This paper examines and suggests a hollow core with four layers of semilunar air-hole-shaped circular photonic crystal fiber (PCF) capable of transmitting terahertz (THz) OAM information-carrying modes. By using the full vector finite element method (FEM), OAM multiplexing is analyzed for the proposed fiber. All the THz OAM-based factors are analyzed at a frequency band ranging from 400 GHz to 800 GHz. For the first time, some important PCF factors such as effective refractive index difference (ERID), dispersion profile (DP), OAM purity, confinement loss (CL), effective mode area (ERA), and numerical aperture (NA) are quantitatively discussed with applications. The proposed design supports 50 OAM modes with ERID up to 10–3. The PCF has a CL of approximately 10–10 dB cm⁻¹ and the lowest dispersion profile is 0.3581 ps/THz/cm. Furthermore, the OAM purity is around 97%. Nonetheless, the proposed design can be used in THz-OAM transmission and high optical fiber communications.

Keywords: Multiplexing Orbital Angular Momentum (OAM), Photonic Crystal Fiber (PCF), Terahertz (THz) transmission, Full Vector Finite Element Method (FEM), Effective Refractive Index Difference (ERID).

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