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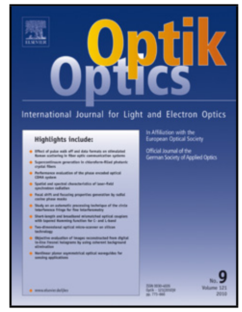


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# Ultra-Wide Mid-IR Supercontinuum Generation in $As_2S_3$ Photonic Crystal Fiber by Rods Filling Technique

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**Abstract:** In this paper, we study fluid infiltration approach and rod filling technique for dispersion engineering of a photonic crystal fiber (PCF) composed of $As_2S_3$-Chalcogenide glass. The numerical results based on finite difference time domain method reveal that when air holes of the innermost ring in a PCF are infiltrated with suitable fluids or filled by glass rods, ultra-flattened near-zero dispersions with high nonlinearities will be achieved over a wide mid-IR wavelength range. The simulations demonstrate that when a 100 fs input optical pulse of 20 kW peak power and central wavelength of 2.5 μm is launched into a 10 mm length of the $As_2S_3$ PCF filled by PBG-08 rods, a ripple-free spectral broadening as wide as 9 μm from 1 to 10 μm can be obtained which is used as a suitable source for Mid-IR applications in molecular fingerprint region such as medical diagnosis of diseases, and drug detection.

**Keywords:** Dispersion engineering; Photonic crystal fiber; Supercontinuum generation, Fluid infiltration, Rod filling.

## 1. Introduction

The advent of a new class of optical waveguides known as photonic crystal fiber (PCF) in the late 1990s has attracted widespread interest by many research groups [1]. In recent years, they have studied the excellent propagation properties of PCFs consist of the linear and nonlinear parameters and tried to control and manage them as desired [2, 3].

Both core and cladding have the same materials and presence of the air holes inside the cladding the smaller effective index than that of the core is achieved [4]. Therefore, the guiding mechanism is governed by the total internal reflection (TIR) inside the PCF [5]. An advantage of a solid core PCF over a conventional optical fiber is its capability of being engineered for a target dispersion [6, 7]. On the other hand, possibility of adjusting the lattice constant and air-hole diameter proposes another degree of freedom for dispersion engineering of a PCF, in a method that is not probable for a conventional fiber [8].

PCFs are interesting candidates for supercontinuum generation (SCG) due to enhanced waveguide nonlinearity [9]. It is because of confining a guided mode and the possibility of fabricating them from a single material with high intrinsic nonlinearity such as chalcogenide, silicon, and tellurite glasses [10].