Towards Manufacture of Ultralow loss Hollow Core Photonic Bandgap Fiber

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Hollow core photonic bandgap fibers (HC-PBGFs) are a class of optical fibers which guide light in a low index core region surrounded by a triangular lattice of air holes separated by a delicate silica web (1). The precise nature of this cladding structure requires extremely fine control of the fabrication parameters. While HC-PBGFs have found wide range of exciting research applications the initially anticipated potential for ultralow loss below that of single mode fiber (SMF) has yet to be realized. To date loss figures as low as 1.7 dB/km (2) have been reported, however surface roughness at the core cladding interface limited further loss reduction (3). The loss of HC-PBGFs can potentially be decreased further by increasing the core dimensions (4) and through optimisation of the fabrication process. To date, the manufacture of HC-PBGF's is reliant upon the two stage stack and draw process. To target ultralow loss below what has been reported to date it has become necessary to ensure repeatability and uniformity in the labor intensive stack and draw process. Repeatability is ensured through rigorous cleanliness throughout preform preparation and by precise fabrication control at each stage of manufacture.

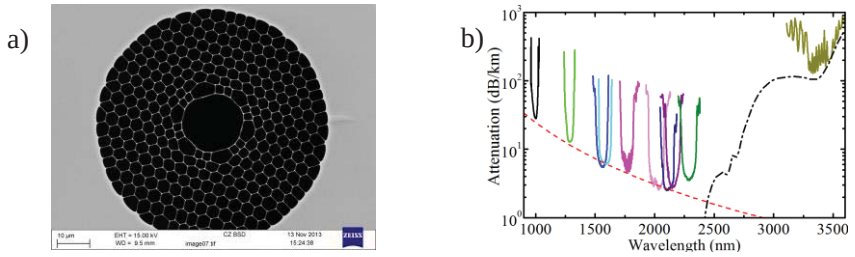

Figure 1) a) Scanning electron micrograph of a 19 cell core defect HC-PBGF, b) Attenuation scaling of the photonic bandgap (PBG) versus central guidance wavelength of 19 cell core defect HC-PBGF. (5)

Greater than 1 km lengths of HC-PBGF (Fig. 1a) can now be drawn with typical attenuations of the order of 2 – 3 dB/km and with significantly improved optical bandwidth (~ 100 nm) compared with previously reported (2). These developments open up HC-PBGF for a range of applications such as telecommunications, laser power delivery, gas sensing and strong light matter interactions, for which they have a clear advantage over conventional fibers. The attenuation scaling of the photonic bandgap (PBG) (solid curves) with central operating wavelength has been investigated in 19 cell core defect fibres (Fig. 1b) (5). The expected attenuation proportional to λ^{-3} relationship (dashed red curve) is observed until the infrared absorption edge of silica (black dot dash curve) is breached and the attenuation increases (green curve). Through strategic fabrication improvements we have achieved repeatable low loss manufacture of HC-PBGF's. Future developments in fabrication control and fiber design will allow the realization of ultralow loss HC-PBGF.

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