Bend Measurements of a Photonic Crystal Fiber with elastomer inclusions

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In their basic form photonic crystal fibers (PCF) typically consist of fused silica with an arrangement of air-holes running along the full length of the fiber. Tailoring and manipulation of the optical and guiding properties of the PCF can be achieved by filling the air-holes with a material of lower or higher refractive index [1].

In this work, we demonstrate both numerically and experimentally the guiding properties of an endlessly single mode (ESM) PCF infiltrated with PDMS elastomer inclusions as shown in Fig 1. PDMS (poly-dimethylsiloxane) elastomer is a polymeric silicone material widely used in the area of photonics, particularly in opto/microfluidics, having unique optical properties. Transparency for a wide range of wavelength, lower refractive index (around 1.41) than fused silica, high elasto-optic coefficients, biocompatibility, minimal loss due to absorption, are some of its features. It is soft and deformable with no shrinkage and combined with its low cost, and ease fabrication procedure is a potential active material for tunable devices and sensing applications [2]. We initially investigate the basic TIR-based guiding properties of the PDMS/Silica PCF using Finite Time Difference Domain (FDTD) method and measure the total transmission loss at different wavelengths. Bend measurements of the PDMS/Silica PCF are experimentally demonstrated at 473, 633 and 1550 nm wavelength as shown in Fig 2. Long-wavelength bend characteristics of the PDMS/Silica fiber are also measured at five different bend diameters utilizing a tunable laser source. At the end, we consider and discuss the potential of the PDMS-infiltrated PCF to act as bend sensor.

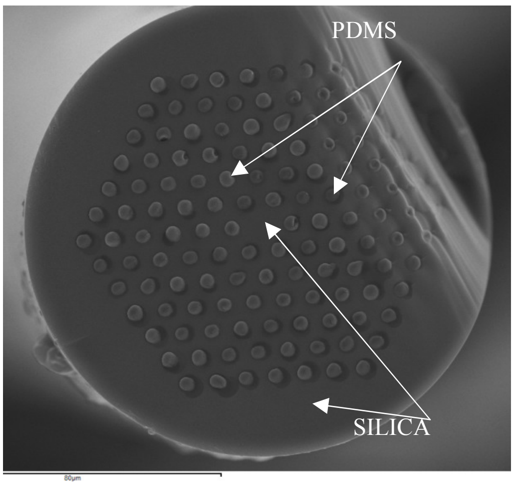

Fig. 1. Scanning Electron Microscopy (SEM) image of PCF infiltrated with PDMS elastomer.

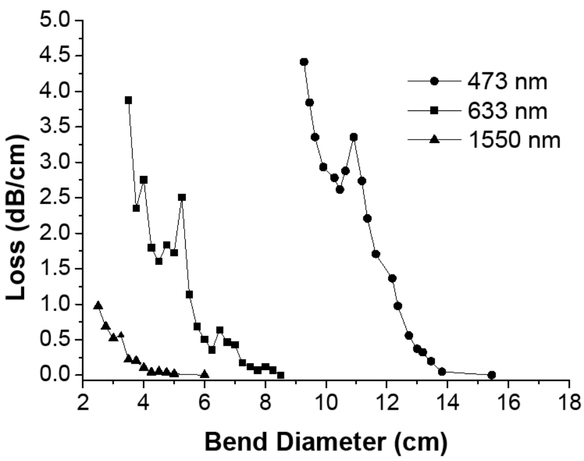

Fig. 2. Bend measurements of PCF with elastomer inclusions at different wavelengths.

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[2] J. C. Lötters, W. Olthuis, P. H. Veltink, and P. BergveldJ. Micromech. Microeng. **7**, 145–147 (1997)