

Nonlinear and acoustic properties of holey optical fibres

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The *holey fibre* (HF) is a new class of optical fibre which has a cladding formed by a number of air holes which run along the length of the fibre. Typical HFs are shown in Figures 1 and 2. These fibres can be made from a single material, and guidance is provided by the difference in effective indices between the core and the 'holey' cladding [1,2]. The microstructured transverse profile opens up a diverse range of novel optical properties, many of which are not possible in more conventional fibre structures [3]. For example, HFs can have anomalous waveguide dispersion at visible wavelengths and be single-mode, which is impossible in conventional fibers.

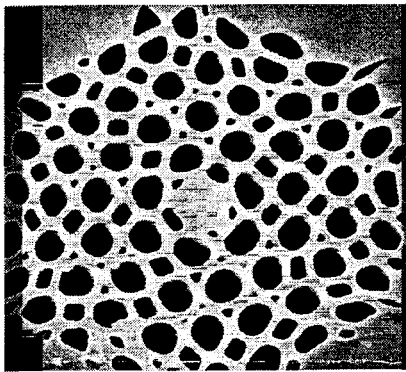


Figure 2. Highly nonlinear holey fibre. Core diameter < 2 microns.

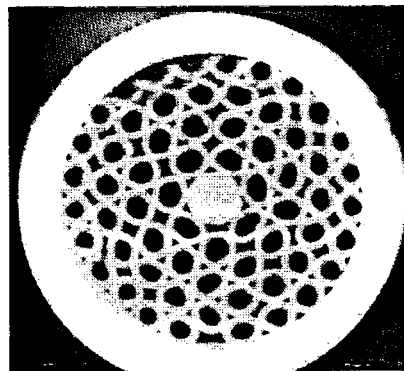


Figure 1. Low nonlinearity holey fibre. Core diameter > 40 microns.

The effective core size in a holey fibre can be tailored dramatically via the choice of cladding geometry, as shown in Figures 1 and 2. In this way, the effective nonlinearity can be tailored over three orders of magnitude. A more direct way to affect the nonlinearity would be to use HFs with a hole-to-hole spacing of less than the wavelength of light. In this regime, a large fraction of the light propagates in the holes [4], and thus by filling the holes with a nonlinear material the nonlinearity could be enhanced. The applications of such high-nonlinearity fibres are diverse, and include switching, continuum generation, solitons below 1.3 microns and dispersion compensation.

Recent improvements in the fabrication processes have allowed the production of long lengths of low loss, high nonlinear holey fibre such as the one shown in Figure 1. Here the nonlinear characteristics of a diverse range of holey fibres are explored. In addition, the influence of the microstructure on the acoustic properties of these fibres is discussed.

References

- 1) J.C. Knight et al., Opt. Lett. 21, 1547 (1996).
- 2) T.A. Birks et al., Opt. Lett. 22, 961 (1997).
- 3) T.M. Monro et al., J. Light. Tech. 17, (1999).
- 4) T.M. Monro et al., Elect. Lett. 35, 1188 (1999).