Fabrication and applications of highly nonlinear silica holey fibres

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Holey fibre (HF) technology provides a new way to fabricate novel highly nonlinear silica based fibres. The cladding of a HF is defined by an arrangement of air holes that run along the fibre length surrounding a central silica core [1]. The reduction in core size and increase in refractive index contrast that is possible in a HF allows the production of fibres with extremely high effective nonlinearity. HFs can also exhibit, by design of the hole configuration [2], dispersion properties not possible in standard fibres, such as anomalous dispersion below 1.3 μm, normal dispersion at 1.55 μm or flattened dispersion over a broad wavelength range.

A wide range of high nonlinearity HFs have been fabricated: see for example figure 1, which combines a small 1.5 μm core with a 125 μm outer diameter, making the fibre robust and practical. We have obtained effective mode areas as small as 2.8 μm^2 at 1.55 μm, and this small core was used to demonstrate a 2R data regenerator using just 3.3m of fibre in the configuration shown in figure 2 [3].

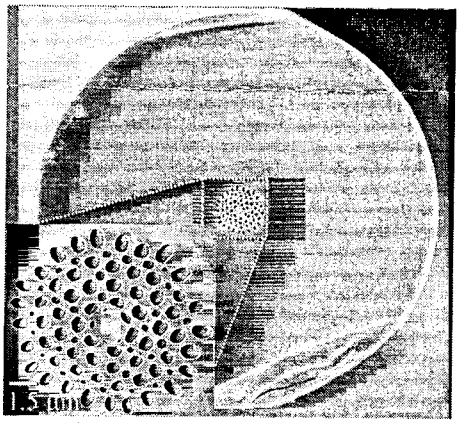

Fig 1. SEM of a HF with a 1.5μm core

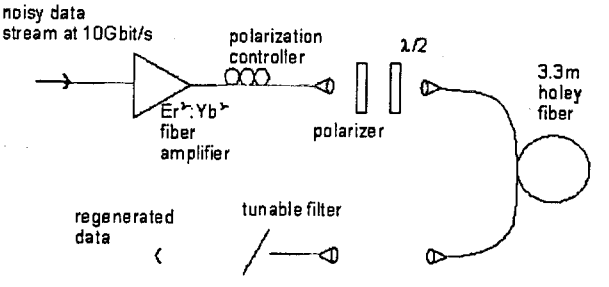

Fig 2. Experimental setup of data regenerator

Using a similar highly nonlinear holey fibre which had anomalous dispersion at 1μm, we directly demonstrated linear dispersion compensation by compressing 2.4 ps positively chirped pulses down to 170 fs [4]. We also demonstrated nonlinear pulse compression and soliton propagation over 20 soliton periods with just 1 mW average power.

References

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[4] J H V Price, W Belardi, L Lefort, T M Monro, D J Richardson, 2001, *Nonlinear Guided Waves and Their Applications*, paper WB1