Improved Flatness of a Supercontinuum at 1.55 μm in Tapered Microstructured Optical Fibres

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Supercontinuum (SC) generation occurs when high-power ultrashort optical pulses propagate through a nonlinear optical medium and it has been investigated since 1970s [1]. Microstructured optical fibres (MOFs) have enabled major advances in obtaining SC spectral broadening over the past decade, leading to the development of new inexpensive and efficient sources. Low cost SC will find new applications in diverse areas such as telecommunications, optical frequency metrology, spectroscopy etc. [1].

SC broadening process strongly depends on the fibre type, pulse duration and pulse energies used, whilst the figure of merit of the quality of spectra is the spectra bandwidth or the best flatness. In this paper we report on a method for enhancing the flatness of the SC at 1.55 μm to allow for spectral splicing for dense DWM applications. This is done via the use of short tapered MOFs which can be easily modelled. We chose to examine several different regions of standard hexagonal structure MOFs on the optical map representing dispersion calculated vs. pitch (*Λ)* and air filling factor (*d/Λ)* and to taper fibres linearly with the profile determined by fibre pitch at the beginning and the end. Our method is based on plotting contour plots for the widest SC bandwidth and the taper length at which it can be achieved, versus input pulse peak powers and FWHM durations. Alternatively, we plot contours for the maximum of the ratio of the bandwidth and calculated standard deviation of the spectra (B/Std) at the required wavelength range and taper's corresponding length (Figs. 1 and 2). Based on the contour plots we determine the parameters of the taper and of the input pulse that provide best SC spectra broadening and flatness. In the example shown, for the input sech pulse with the input pulse peak power 5 kW and 300 fs FWHM width in the taper 0.1 m long, the resulting spectrum is < 20dB in the range from 1350 nm to 1900 nm (Figs. 3 and 4). The results show the advantages of this procedure that enables ease of determination of the input pulse conditions and taper parameters to achieve quality in SC.

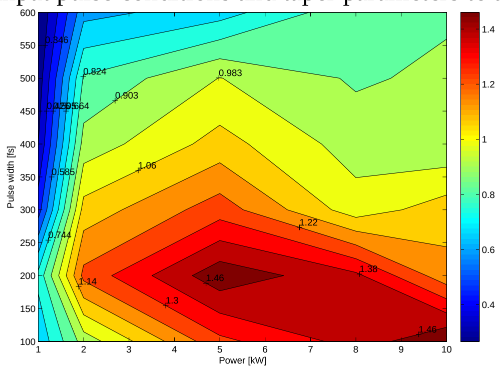

Fig.1 Maximum B/Std for tapered fibre *Λ* changes from 1.2 μm to 1.16 μm, when *d/Λ*=0.95

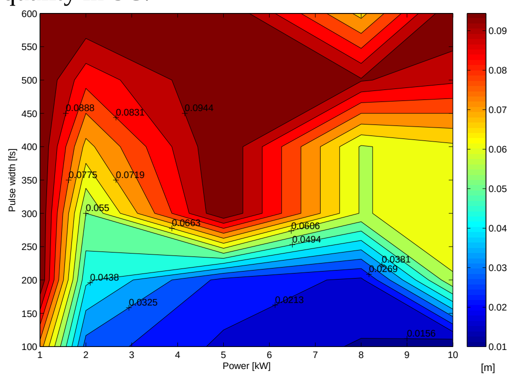

Fig.2 Taper length where best (maximum) B/Std for tapered fibre *Λ* changes from 1.2 μm to 1.16 μm, when *d/Λ*=0.95

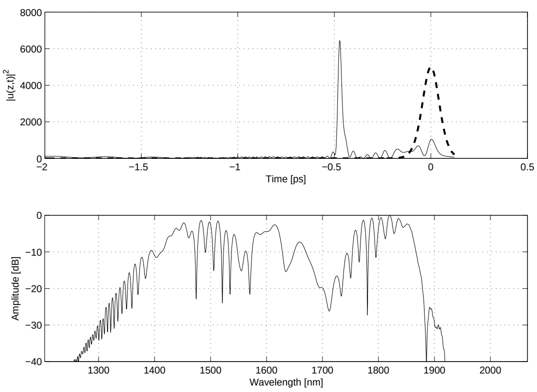

Fig.3 Top: pulse envelope, input (--) and output (-); Bottom: normalized spectrum vs. wavelength

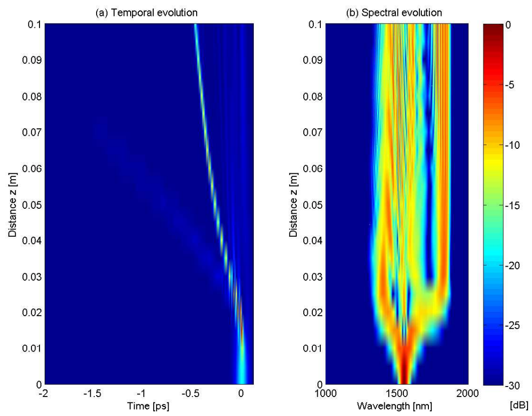

Fig. 4 a.) Temporal and b.) Spectral evolution, in the tapered fibre for selected propagation distances

References

[1] M. Dudley, G. Genty and S. Coen, "Supercontinuum Generation in Photonic Crystal Fiber", Review of Modern Phys., Vol 78, Oct.-Dec. 2006.