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Highly coherent supercontinuum generation in an inline silica optical fiber structure

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Abstract: The supercontinuum generation with high coherence is experimentally demonstrated in a 14.5 cm long inline silica optical fiber structure involving a pre-pulse-compression. Simulation shows better results can be expected with the further improvement.

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1. Results

Fig. (a) Dispersion of the MOF (red solid and dash: measured and simulated) and taper (blue: simulation). Inset A and B: respective SEM images. Inset C: the schematic of the inline optical fiber structure. (b) Normalized autocorrelation traces of pulses before (blue) and after (red) compression. (c) Upper plot is the simulated modulus $|g_{12}|$. Below shows measured (red) and corresponding simulated (blue) SC spectrum. The dash grey curve shows the simulated spectrum when the input power increases to 106 mW with the MOF length shortened to 10.4 cm.

Supercontinuum (SC) becomes essential for many applications. We report a SC generation with highly coherence in a 14.5 cm long inline silica optical fiber structure illustrated by inset C in Fig.1.(a). An anomalous dispersion micro-structure optical fiber (MOF) which compresses the input pulse was tapered down to shrink the pitch and hole sizes independently to achieve the normal dispersion for SC generation shown in Fig.(a). The lengths of MOF and taper are 13.5 cm and 1 cm respectively. We compressed a 1550 nm pulse with the pulse width of around 500 fs to around 60~80 fs in the MOF section only with the power of 70 mW depicted by Fig.(b). Sufficient linear pre-up-chirp can suppress the pedestal for a higher compressed peak power [1]. We used the same input pulse, ensuring unbroken-up pulses entering into the taper, to investigate the broadening in the entire inline fiber structure. The SC spectrum obtained at the 1 cm long normal dispersion taper, extends from 1070 nm to 2137 nm at a -40 dB level from the maxima at the central sharp peak, though not fully developed. Our simulation agrees well with the experiment result, and also indicates broader spectrum with better flatness can be expected when shorten the MOF length with a higher input power. The simulated modulus to quantify the degree of coherence, $|g_{12}|$, inclusive of the random noise [2,3] shows that the spectrum is highly coherent across the bandwidth.

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3. References

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