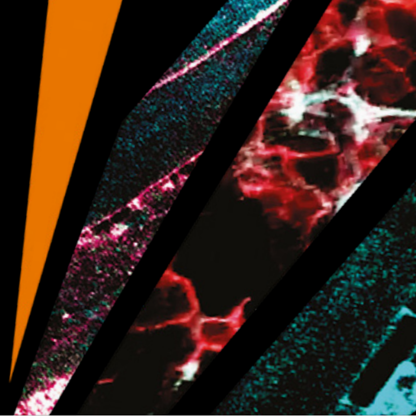

Supercontinuum Generation

using the Chromacity 1040

The high-peak-power pulses (>100 kW) from the Chromacity 1040 femtosecond laser make it easy to drive nonlinear effects like optical parametric oscillation, supercontinuum generation and Raman soliton creation. We discuss how to implement supercontinuum generation in nonlinear fiber to provide a cost-effective means of producing broadband near-infrared light for spectroscopy, optical coherence tomography, CARS spectroscopy / microscopy and other applications.

Supercontinuum and Raman soliton generation

The Chromacity 1040 is an ideal source to generate a cost-effective near-infrared supercontinuum by focusing ultrashort pulses into non-linear materials, such as photonic crystal fibers. The high energy per pulse, and free-space beam from the Chromacity 1040 is ideally suited for coupling into optical fibers. Unlike solid-state lasers, which tend to produce beams with an elliptical cross-section (due to astigmatism in the laser cavity), the Chromacity 1040's output originates from a single-mode fiber, so it is perfectly symmetric.

Light from the Chromacity 1040 can be coupled into commercially available photonic-crystal fibers with efficiencies of greater than 75%. We recommend the use of connectorized photonic crystal fibers to minimise the risk of fiber damage and also contamination. The recommended fiber-launch arrangement is shown in Fig. 1. Unlike Ti:sapphire lasers, the laser is insensitive to small amounts of light reflected from the fiber facet, eliminating the need for an optical isolator between the laser and the fiber.

The Chromacity 1040 (shown in Fig. 2.) produces horizontally polarized light directly from the laser. When coupling into polarization - maintaining or photonic-crystal fiber it is important to align the polarization of the laser to the fiber's structure. This can be done by using a pair of quarter and half waveplates, available separately from Chromacity see (Fig 2). When using photonic-crystal fiber, coupling efficiency improvements of around 10% are possible by optimizing the input polarization.

While a microscope objective may be used, for best efficiency and to reduce dispersive broadening of the pulses, an aspheric lens is recommended whose focal length matches the beam diameter of the Chromacity 1040 to the fiber core size. Careful selection avoids the need to telescope the beam prior to the fiber, improving stability and reducing unnecessary loss.

The data in Fig. 3 (overleaf) show supercontinuum spectra generated using 1.5 m of NKT SC-3.7-975 fiber, along with simulation results obtained using the measured pulses from the Chromacity 1040. The ability to predict the supercontinuum which will be generated using the laser makes it easy to select the ideal nonlinear fiber for your application. Chromacity can provide customers with simulation data informing their choice of fiber type and length.

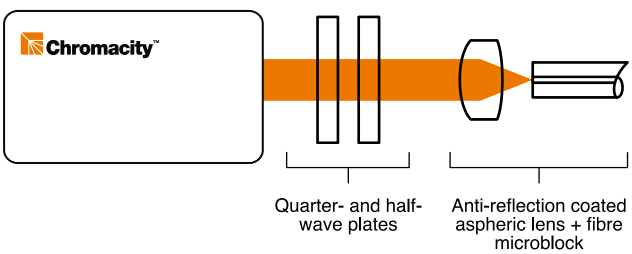

FIGURE 1. Standard layout for coupling the Chromacity 1040 into a fiber

FIGURE 2. Chromacity 1040

sales@chromacitylasers.com

Chromacity™

Supercontinuum Generation

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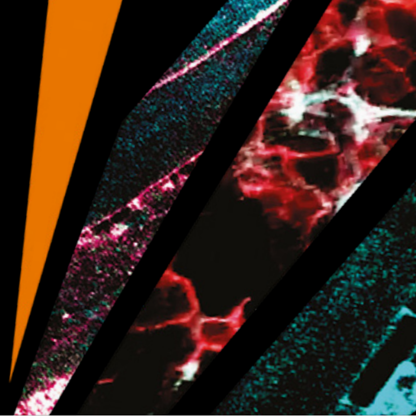

For some applications only the near-infrared output of the supercontinuum is required. When using pulses of sufficiently short duration, such as those produced by the Chromacity 1040, the Raman soliton generated above 1200 nm can be filtered to produce transform-limited sub-100-fs pulses with average powers of up to 50 mW. The centre wavelength of this soliton can be tuned over 100 nm by adjusting the coupled power, depending on the nonlinear fiber used.

Summary

Exceptionally broad and flat supercontinua from 750-1300 nm can be produced using the Chromacity 1040 femtosecond laser, which delivers excellent coupling efficiencies and easy fiber-launch requirements. The high natural stability of the system means that supercontinuum generation is stable and easily generated for real-world applications. Please contact us for advice on achieving your required supercontinuum spectrum.

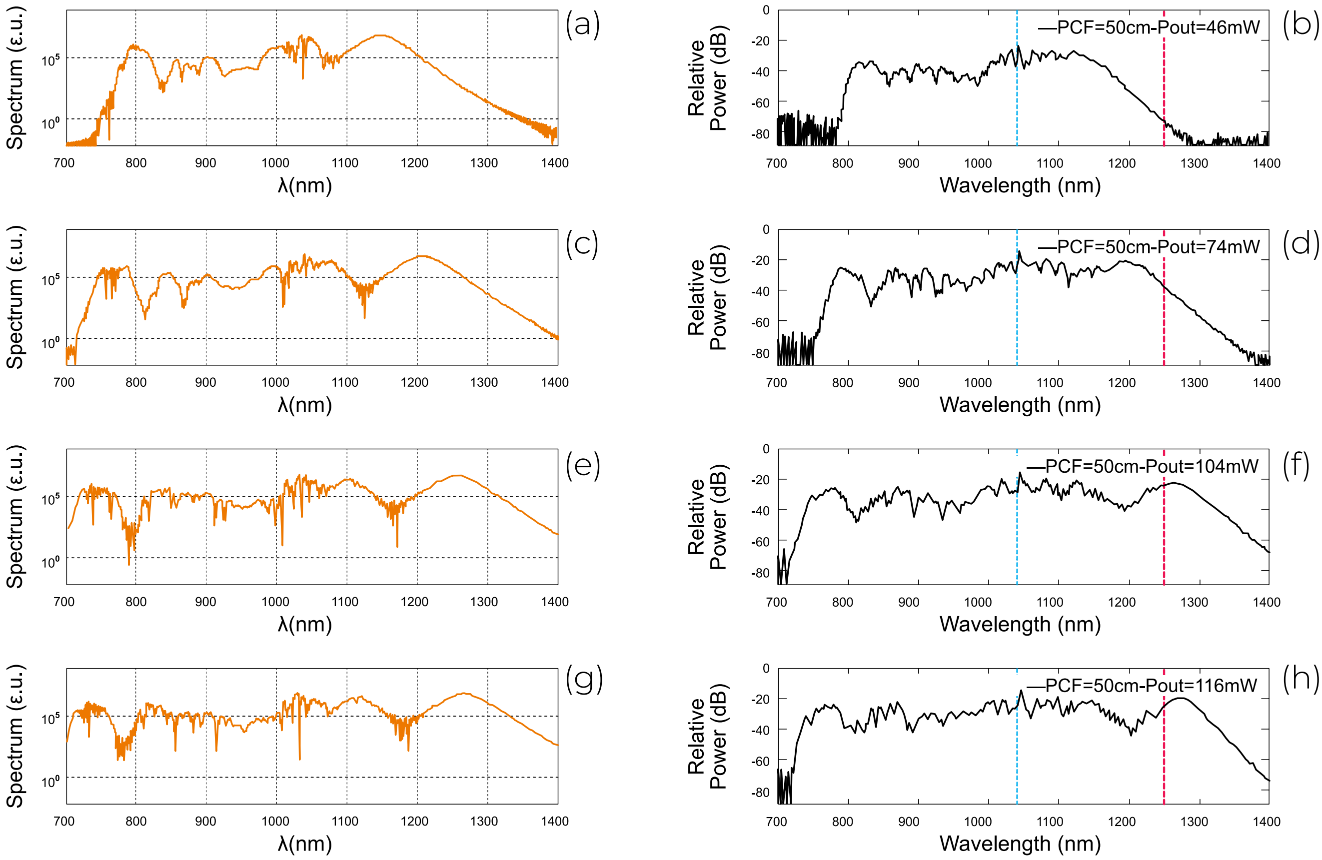

FIGURE 3. Supercontinuum spectra generated using 1.5 m of SC-3.7-975 nonlinear PCF. (a), (c), (e) and (g) Simulated results. (b), (d), (f) and (h) Experimental results for same fiber and coupled powers.

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