Influence of dispersion of nonlinearity on coherent supercontinuum generation bandwidth in photonic crystal fibers pumped at 2 \( \mu \)m - DTU Orbit (06/11/2019)

Sources of spectrally broadband and coherent light are necessary for frequency metrology and ultrashort pulse generation. Near-infrared (NIR) wavelengths are practical for such devices because of the emergence of robust and reasonably priced femtosecond lasers operating in this part of the spectrum. This further enabled pulse preserving and coherent, so-called all-normal dispersion supercontinuum (ANDi SC), covering over a full octave of around 600–1600 nm with pulse duration post-compressed down to single optical cycles [1]. When using the new erbium (1560 nm) or thulium (around 2000 nm) femtosecond lasers as pump sources, exceeding the 2400 nm barrier has proved a challenge. ANDi SC requires strong nonlinear response of the optical material, since self-phase modulation (SPM) and optical wave breaking (OWB) mediated four-wave mixing (FWM) are almost exclusively shaping the ANDi SC pulses. Flatness of the normal dispersion profile is also important, because FWM in this case is not phase-matched and takes place at the instance of the temporal overlap of the OWB components. Here we investigate and explain the bandwidth limitation of NIR pulse-preserving coherent SC by confronting ANDi SC generation performance in two types of photonic crystal fibers (PCFs) — Fig. 1(a, b) [2]. One type (NC21 series) has a flat NIR dispersion profile at the cost of nonlinearity, due to low nonlinear refractive index \( n_2 \) the glasses forming the PCF lattice. The other type (NC38 series) features weaker dependence of the effective mode area \( A_{\text{eff}} \) on wavelength and much higher nonlinearity, albeit at the cost of flatness of the engineered normal dispersion profile.