Mid-infrared supercontinuum generation to 12.5μm in large NA chalcogenide step-index fibres pumped at 4.5μm

We present numerical modeling of mid-infrared (MIR) supercontinuum generation (SCG) in dispersion-optimized chalcogenide (CHALC) step-index fibres (SIFs) with exceptionally high numerical aperture (NA) around one, pumped with mode-locked praseodymium-doped (Pr3+) chalcogenide fibre lasers. The 4.5μm laser is assumed to have a repetition rate of 4MHz with 50ps long pulses having a peak power of 4.7kW. A thorough fibre design optimisation was conducted using measured material dispersion (As-Se/Ge-As-Se) and measured fibre loss obtained in fabricated fibre of the same materials. The loss was below 2.5dB/m in the 3.3-9.4μm region. Fibres with 8 and 10μm core diameters generated an SC out to 12.5 and 10.7μm in less than 2m of fibre when pumped with 0.75 and 1kW, respectively. Larger core fibres with 20μm core diameters for potential higher power handling generated an SC out to 10.6μm for the highest NA considered but required pumping at 4.7kW as well as up to 3m of fibre to compensate for the lower nonlinearities. The amount of power converted into the 8-10 μm band was 7.5 and 8.8mW for the 8 and 10μm fibres, respectively. For the 20μm core fibres up to 46mW was converted.

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