Two octave mid-IR supercontinuum generation using tellurite step-index fibers

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Abstract

The interest in the development of broadband supercontinuum (SC) fibered laser sources in the mid-infrared (MIR) never cease to increase in the last decade because of its potential in various fields of application such as spectroscopy, defense, medical science and others. Silica was first investigated for such system but tellurite glasses quickly become a more suitable alternative because of their 1-6 μm transparency widow, high nonlinear optical properties (10 times that of silica) and moderate dispersion (bulk ZDW around 2 μm). Microstructured optical fibers (MOF) are good waveguides to generate large supercontinuum but exhibit some ageing issues which leads to a decreasing efficiency in SC generation over time. To avoid this problem, high numerical aperture step-index fibers are an alternative. We report here a study on the drawing of a step-index fibers using a pair of tellurite with a refractive index difference of 0.138 at 1550 nm. Fibers with large core (40 μm) and small cores (between 3 and 5 μm) are drawn. The background losses for large-core step-index fibers are around 1 dB/m between 1 and 3 μm. The chromatic dispersion of the small core fibers as a function of core diameter is discussed, and numerical simulations based on the generalized nonlinear Schr´odinger equation are performed to explore supercontinuum generation in these fibers. Fibers exhibiting a flat dispersion with two ZDWs are then experimentally tested. The pumping of this fibers with an OPO near their ZDW allow the generation of a supercontinuum in the infrared with a good agreement between numerical simulations and experimental results. Different parameters such as pump wavelength, fiber length and the core size influence on the SC generation were investigated. The maximum extension we managed to obtain starts around 1 μm and exceeds 5 μm, covering the IR fingerprint patterns of various molecules.

Keywords: Tellurite glasses, Supercontinuum generation, nonlinear optics

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