Fabrication and characterization of chromium-doped nanophase separated yttria–alumina–silica glass-based optical fibers

Debjit Dutta, Anirban Dhar, Alexander V. Kir'yano2, Shyamal Das, Sandip Bysakh and Mukul C. Paul.

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Abstract.

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The basic material and optical properties of chromium-doped nanophase-separated yttria–alumina–silica (YAS) glass based optical preforms and fibers, fabricated through the modified chemical vapor deposition process in conjunction with solution doping technique under suitable thermal annealing conditions are reported. The size of the phase-separated particles within the core of the annealed preform is around 20–30 nm which is significantly reduced to around 5.0 nm in the drawn fiber. The absorption spectra of fibers drawn from the annealed and non-annealed preform samples revealed the presence of Cr4+, Cr3+, and Cr6+ specie. Numerically, extinction of absorption drops ~3–3.5 times for the annealed sample as a result of nano-phase restructuration during annealing process. Intense broadband emission (within 500–800 nm) in case of the annealed preform sample is observed as compared to the non-annealed one and is associated with the presence of Cr3+ ions in nanostructured environment inside the YAS core glass. The final fibers show broadband emission ranging from 900 to 1400 nm under pumping at 1064 nm which is attributed mainly to the presence of Cr3+/Cr4+ ions. The fabricated fibers seem to be a potential candidate for the development of fiber laser sources for the visible and near-infra ranges and for effective Q-switching units for ~1–1.1 μm all-fiber ytterbium lasers.