Ho-doped tellurite glasses for emission in the mid infrared wavelength region

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Rare earth doped fiber lasers for emission in the infrared wavelength region above 1.55 micron are of great interest for several applications, including eye-safe LIDAR and DIAL systems for defence applications [1]. In particular single frequency sources emitting above 2 micron would allow longer coherent length and thus better sensitivity for coherent detection at long distance, thanks to the atmospheric transmission window available [2]. Ho^{3+} ions are interesting for their ability to provide the following efficient radiative decays: $^5I_7 \rightarrow {}^5I_8$ at 2.1 μm and $^5I_6 \rightarrow {}^5I_7$ at 2.9 μm by pumping with suitable laser diodes [3]. Tellurite glasses are promising candidates for laser sources in the near infrared, thanks to the lowest phonon energy among oxide glasses, the ability of hosting higher amounts of dopants than silicate glasses and a higher stability than fluoride and chalcogenide glasses [4,5].

In this paper the emission of Ho^{3+} ions at 2.1 μm in tellurite glasses was explored by fabricating a single mode double cladding Ho-doped tellurite optical fiber, co-doped with Tm^{3+} ions to allow pumping at 793 nm. The intention was to optimize a fiber for future single mode narrow linewidth compact fiber laser for Lidar systems. The fiber was characterized both morphologically and in its optical properties: optical attenuation losses were measured; fluorescence spectra both in the visible and in the infrared wavelength region were recorded by pumping the fiber core with a 793 nm SM diode laser.

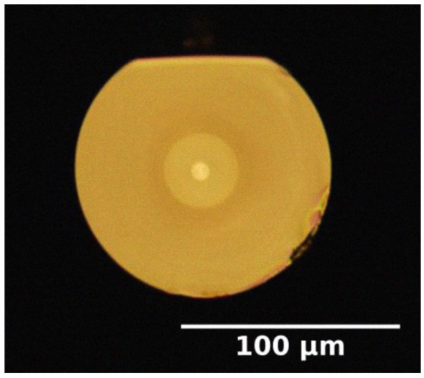

Fig. 1 Optical micrograph of the single mode Tm-Ho doped tellurite optical fiber fabricated for emission at 2.1 μm.

The Ho^{3+} ion fluorescence at 2.9 μm was then preliminary studied by preparing novel tellurite glass systems with minimized water content to allow for efficient emission at a wavelength where OH group absorption is a major issue and produces quenching of the targeted wavelength laser source. Chemical-physical and optical characterizations were performed on all samples and in particular fluorescence was measured by pumping with suitable lasers to obtain either infrared or visible emission. On the basis of the lifetime measurements and fluorescence spectra, the most suitable glass compositions demonstrating efficient emission for Ho^{3+} ions are identified. The effort was sponsored by the Air Force Office of Scientific Research, Air Force Material Command, USAF, under grant number FA8655-09-1-3111. The U.S. Government is authorized to reproduce and distribute reprints for Government purpose notwithstanding any copyright notation thereon.

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