Tm^{3+} doped tellurite glass for S band amplifiers

L. N. Ng, N. P. Sessions, J. Nilsson, W. S. Brockelesby and E. R. Taylor
Optoelectronics Research Centre, University of Southampton, S017 1BJ, Southampton, UK
email: ln@orc.soton.ac.uk, nps@orc.soton.ac.uk,, jn@orc.soton.ac.uk, wsb@orc.soton.ac.uk, em@orc.soton.ac.uk,

Abstract

In the past, much effort has been devoted solely to the development of fiber amplifiers operating in the C(1530-1560nm) and L(1560-1610nm) bands based on Er^{3+}-doped fiber amplifiers. However, with the rapid increase in data transmission, the demand for a larger bandwidth to handle a larger transmission capacity has become vital. We report on the spectroscopy and gain measurements in a thulium(Tm^{3+}) doped tellurite glass for broadband amplification in the S band(1440-1530nm).

The composition presented here is LTT: $25Li_2O+5TiO_2+70TeO_2$. Based on DTA measurement, the glass transition temperature of T_g is ≈270°C and there is no apparent crystallization. The 1470nm fluorescence profile is independent of concentration and the fullwidth at half maximum is ≈106nm which is at least 30nm broader than that reported in fluoride ZBLAN glass. The 1470nm transition is ≈97% radiative, the effect of OH quenching is minor and the glass can accept large dopant levels. The $^3H_4$-$^3F_4$ transition is self-terminating unless the lower $^3F_4$ level is depopulated. Our results on a 2000ppm Tm^{3+}-Ho^{3+} codoped LTT glass shows a 33% reduction in the lifetime of the $^3F_4$ state without affecting the lifetime of the $^3H_4$. It is estimated that a Ho^{3+} concentration of 10,000ppm is required.

A multimode LTT fiber doped with 2000ppm of Tm^{3+} with a NA of ≈0.45 and a core diameter of 40μm has been fabricated. The background loss is 3dB/m at 1μm. Gain measurements were performed in free space configuration using 800nm from a Ti:Sapphire laser as a pump source and a HP tunable laser diode between 1470nm and 1580nm as the signal source. The pump power incident on the fiber was ≈1W uncorrected for coupling losses whilst the signal power was maintained at –55dBm. A 0.30m length fiber shows gain extending to a longer wavelength(1560nm) than that reported in ZBLAN. An average gain of 4dB was measured at 1470nm and the gain increases with pump power with a pump efficiency of ≈3.5dB/W. The gain figure and pump efficiency will improve significantly in a single mode fiber.