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SPECTROSCOPIC CHARACTERISTICS OF Er-DOPED $LiNbO_3$

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Er-doped $LiNbO_3$ has recently been strongly pursued as an integrated laser source at 1550nm due to the potential offered by the host material for electro-optic, acousto-optic and non-linear interactions, and several devices have been demonstrated for advanced laser applications[1].To fully exploit this laser system, it is important to know the spectral characteristics of the dopant-host combination and to quantify the radiative and nonradiative transitions between different excited levels in order to be able to predict and optimise the device performance. For example, it is well known that pumping Er-doped devices at 980nm provides high efficiencies (in dB/mW) and signal-to-noise ratios [2]. However, the Er:$LiNbO_3$ devices demonstrated thus far have been pumped at 1480nm, due to the problems associated with photorefractive damage and upconversion at 980nm. Recent results in Nd:$LiNbO_3$ have shown that the photorefractive damage at near IR wavelengths can be suppressed sufficiently to allow laser operation [3]. Furthermore, recent investigations using XSW have revealed that Er^{3+} ions in $LiNbO_3$ are located in an octahedral position close to a Li site[4], thus allowing the incorporation of high concentrations of Er^{3+} in this host material without fluorescence quenching. This leads to the belief that the upconversion at 980nm is due to a resonant two stage ESA process involving a single erbium ion.

In this paper we present a Judd-Ofelt analysis of Er^{3+} ions in $LiNbO_3$ using measured line-strengths of 10 transitions from the ground state to excited state manifolds, and use these line strengths to evaluate ESA transition strengths from the $^4I_{13/2}$ and $^4I_{9/2}$ levels. Measured oscillator strengths at 300K are compared with calculated electric and magnetic dipole oscillator strengths and the results are found to be within the typical uncertainties associated with these types of calculations. Measured and calculated lifetimes will be compared and used to deduce the quantum efficiencies of the various excited levels. Upconversion at 980nm will be discussed in the light of these results.

References:

1. W. Sohler, IPR '95, Dana Point, paper IFC1, p. 212.
2. W.J.Miniscalco, J. Lightwave Technology, vol. 9, no. 2, p. 234 (1991).
3. J.Amin et al, Optics Letters, vol. 19, no 19, p. 1541 (1994).
4. Th. Gog et al, Physics Letters A, vol. 181, no. 5, p. 417, (1993).