REPLY TO 'COMMENT ON 'LUMINESCENCE FROM LiNbO3' '

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13. ABSTRACT

It is shown that the luminescence from $LiNbO_3$ reported earlier (Appl. Phys. Lett. 20, 197 (1972)) is due to a small amount (less than 1 ppm) of chromium impurities.

KEYWORDS: Littrium niobate, Cr-impurity, Luminescence

Reply to "Comment on 'Luminescence from $LiNbO_3$'"

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The authors appreciate Glass's interest in their paper[1,2] and they apologize for not referring to his article[3] and that of Burns *et al.*[4]

There is a discrepancy between the peak wavelength observed by Glass[3] (9350 Å), Burns *et al.*,[4] (9200 Å) and the authors (8400 Å), but as suggested by Glass in his comment, this discrepancy could be caused by differences in the spectral response of the various detection systems. To check whether this was the case, a sample of Cr-doped $LiNbO_3$ containing 0.015% Cr by weight (425 ppm) was tested in our experimental setup. The spectral content of the luminescence from this doped sample was found to be identical with the luminescence from our undoped samples except for a relatively lower output below 8000 Å. This latter discrepancy could be due to absorption of the luminescence in the doped sample. The output from the doped sample was 600–700 times larger than from our undoped sample. It thus appears that the observed luminescence is indeed caused by Cr.

The spectral sensitivity of the detection system has been determined using a commercial spectral irradiance source. When the luminescence output spectrum is corrected against the spectral calibration curve, the peak output occurs at 8700 Å.

It is known that the Li_2CO_3 used as starting material for our crystals contained 1 ppm Cr. An impurity analysis using emission spectroscopy, has been made of one of our undoped samples. But with a lower detectivity of 1 ppm, no Cr could be detected. This is consistent with the measured ratio of luminescence power between the doped and undoped samples which indicates a Cr content of less than 1 ppm in the undoped sample.

Since our paper[1] was published, the luminescence from $LiNbO_3$ has been studied using laser pump sources at 4730, 5320, 5620, and 6590 Å in addition to the ruby wavelength. The spectral content of the luminescence is the same for all these frequencies indicating that the luminescence is caused by an impurity. Further, the variation in output with various pump wavelengths and polarizations is in qualitive agreement with the absorption spectrum found by Glass.[3]

As discussed in our paper[2] there are similarities in the temperature dependence between the observed luminescence and the optical damage indicating a possible connection between the two phenomena. Further, no luminescence was observed in $Ba_2NaNb_5O_{15}$ where the optical damage phenomenon is much less prevalent than in $LiNbO_3$, nor in proustite which does not show optical damage. But the unpublished experiments referred to by Glass showing that the Cr^{3+} ion concentration have no effect on index damage suggest that the similarities between the index damage and the luminescence are coincidental rather than real.

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[1] A. M. Glass, J. Appl. Phys. 44, 508 (1973).
[2] A. Hordvik, and H. Schlossberg, Appl. Phys. Lett. 20, 197 (1972).
[3] A. M. Glass, J. Chem. Phys. 50, 1501 (1969).
[4] G. Burns, D. F. O'Kane, and R. S. Title, Phys. Lett. 23, 56 (1966).

