REPLY TO 'COMMENT ON 'LUMINESCENCE FROM LiNbO3' '

A. Hordvik, et al

Air Force Cambridge Research Laboratories
L. G. Hanscom Field, Massachusetts

7 August 1972
Best Available Copy
REPLY TO "COMMENT ON 'LUMINESCENCE FROM LiNbO₃' "

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)
A. Hordvik
H. Schlossberg

6. REPORT DATE
16 February 1973

7a. TOTAL NO. OF PAGES
1

7b. NO. OF REFS
4

9a. ORIGINATOR'S REPORT NUMBER(S)
AFCRL-TR-73-0103

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

13. ABSTRACT

It is shown that the luminescence from LiNbO₃ reported earlier (Appl. Phys. Lett. 20, 197 (1972)) is due to a small amount (less than 1 ppm) of chromium impurities.
Reply to "Comment on 'Luminescence from LiNbO₃'"

A. Hordvik and H. Schlossberg
Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01730
(Received 7 August 1972)

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

There is a discrepancy between the peak wavelength observed by Glass² (3350 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 LiNbO₃ 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 spectrometric 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 Li₂CO₃ 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 was published, the luminescence from LiNbO₃ has been studied using laser pump sources at 4730, 5320, 5620, and 6960 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 qualitative agreement with the absorption spectrum found by Glass.³

As discussed in our paper 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 Ba₃AI₃Nb₂O₉ where the optical damage phenomenon is much less prevalent than in LiNbO₃, and in poled Ti crystal which does not show optical damage. But the unpublished experiments referred to by Glass showing that the Cr³⁺ ion concentration have no effect on index damage suggest that the similarities between the index damage and the luminescence are coincidental rather than real.

The authors are very grateful to Dr. Glass for supplying the crystal including the measurement of Cr concentration. The emission spectroscopy was performed by L. Fitzgerald, Air Force Cambridge Research Laboratory.