



**HAL**  
open science

# Photorefractive Lithium Niobate crystals: light polarisation rotation highlighted by transmission Raman spectroscopy

Ninel Kokanyan, Marco Bazzan, D. Chapron, Marc D. Fontana

► **To cite this version:**

Ninel Kokanyan, Marco Bazzan, D. Chapron, Marc D. Fontana. Photorefractive Lithium Niobate crystals: light polarisation rotation highlighted by transmission Raman spectroscopy. *Journal of Physics: Conference Series*, 2017, 867 (1), pp.12035 - 12035. 10.1088/1742-6596/867/1/012035 . hal-01582077

**HAL Id: hal-01582077**

**<https://hal.science/hal-01582077>**

Submitted on 5 Sep 2017

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

## Photorefractive Lithium Niobate crystals: light polarisation rotation highlighted by transmission Raman spectroscopy

This content has been downloaded from IOPscience. Please scroll down to see the full text.

View [the table of contents for this issue](#), or go to the [journal homepage](#) for more

Download details:

IP Address: 185.158.134.194

This content was downloaded on 06/07/2017 at 13:19

Please note that [terms and conditions apply](#).

You may also be interested in:

[Formation of Photonic Structures in Photorefractive Lithium Niobate by 1D and 2D Bessel-like Optical Fields](#)

A Inyushov, P Safronova, I Trushnikov et al.

[The two photorefractive centres in iron doped nearly stoichiometric lithium niobate crystals](#)

Li Xiao-Chun, Kong Yong-Fa, Wang Li-Zhong et al.

[Photorefractive Effect in Proton-Exchanged Waveguiding Layers Formed on Lithium Niobate and Lithium Tantalate Crystals](#)

Yukiko Kondo and Yoichi Fujii

[Two-Dimensional Visualization of Photoinduced Refractive Index Change in Photorefractive Lithium Niobate Crystal](#)

Akira Shiratori, Ryuji Aida, Ryohei Hagari et al.

[Light-Induced Domain Inversion in Mg-Doped near Stoichiometric Lithium Niobate Crystals](#)

Liu Hong-De, Kong Yong-Fa, Hu

Qian et al.

[Manifestation of a photorefractive effect in Raman spectra of lithium niobate crystals of different compositions](#)

N V Sidorov, P G Chufyrev, M N Palatnikov et al.

[Forward Phase Conjugation Wave due to Multi-wave Coupling and Grating Share in Lithium Niobate Crystal](#)

Qiao Hai-Jun, Xu Jing-Jun, Zhang Xin-Zheng et al.

[Controlled, Periodic Domain Formation in Strontium Barium Niobate Induced by Volume Holograms](#)

Anthony Kewitsch, Mordechai Segev, Amnon Yariv et al.

# Photorefractive Lithium Niobate crystals: light polarisation rotation highlighted by transmission Raman spectroscopy

N Kokanyan<sup>1,2</sup>, M Bazzan<sup>3</sup>, D Chapron<sup>1,2</sup> and M D Fontana<sup>1,2</sup>

<sup>1</sup>CentraleSupélec, Laboratoire Matériaux Optiques, Photonique et Systèmes, 2 rue E. Belin, 57070 Metz, France

<sup>2</sup>Université de Lorraine, Laboratoire Matériaux Optiques, Photonique et Systèmes, 2 rue E. Belin, 57070 Metz, France

<sup>3</sup>Physics and Astronomy Department, Università di Padova, Via Marzolo 8, 35131 Padova, Italy

E-mail: [ninel.kokanyan@centralesupelec.fr](mailto:ninel.kokanyan@centralesupelec.fr)

**Abstract.** Transmission Raman spectroscopy experiments as a function on time were carried out on iron doped photorefractive congruent lithium niobate crystals. A big change with time in Raman spectra is observed when the incident light is polarized along ordinary axis. The mentioned breaking of Raman selection rules is originated by photorefractive properties of the crystal.

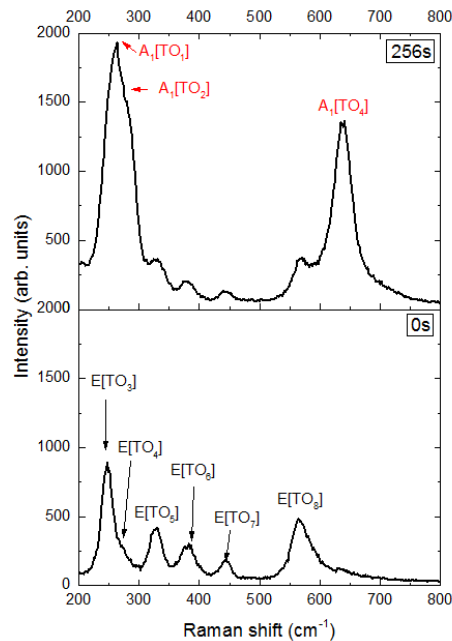
## 1. Introduction

Lithium Niobate (LN) is a multifunctional crystal with piezoelectric, ferroelectric and nonlinear optical properties [1]. The photorefractive (PR) effect is one of the most widely investigating properties in LN [2]. The main interest concerns application to holographic memory [3]. PR effect is largely enhanced in Fe-doped LN, [1-2] and is much reduced as the dopant is Zr 2% [4]. The main drawback of PR is the defocusing of the light beam inside the crystal [5]. Raman spectroscopy is a well-known technique providing information about vibrational and structural properties of a material. Here we use Raman spectroscopy to evidence the change of polarisation accompanying the light defocusing.

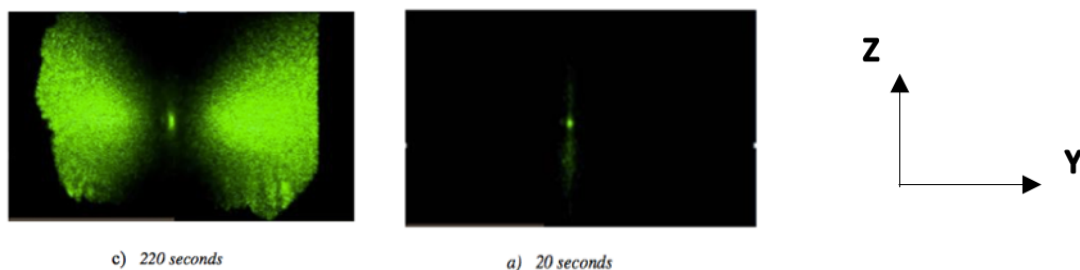
## 2. Experimental results and discussion

Transmission Raman spectroscopy measurements were performed on 0.03mol% and 0.05mol% iron doped LN crystals and spectra were recorded as a function of time. A diode laser with a radiation at the wavelength of 532nm was used. For X(YZ)X configuration the evolution of transmission Raman spectra with time is plotted in figure 1. For this configuration, only E[TO] modes are expected according to Raman selection rules. We observe that A<sub>1</sub>[TO] lines unexpected by Raman selection rules and symmetry [6], are activated with time, and notably differ from data recorded in back-scattering [7]. The transmitted beam pattern with the same X(YZ)X configuration was recorded at different moments and is presented below (figure 2). The defocusing of transmitted beam with time is due to the polarization transmission from ordinary to extraordinary axis [8].





**Figure 1.** Transmission Raman spectra as a function of time in X(YZ)X configuration.



**Figure 2.** Recorded beam pattern of transmitted beam at 20 seconds and 220 seconds for X(YZ)X configuration

### 3. Conclusion

Transmission Raman spectra recorded with X(YZ)X configuration leads to breaking of Raman selection rules with activation of unexpected lines. This activation with time of forbidden  $A_1[TO]$  Raman lines for this configuration result from photorefractive internal field which causes the polarization conversion from ordinary to extraordinary polarization and is originated by photorefractivity of the crystal.

### References

- [1] Volk T R and Woehlecke M 2008, *Springer Series in Materials Science*.
- [2] Günter and Huignard 1988, *JP Edts.* **1**, 131.
- [3] Adibi A, Buse K, and Psaltis D 1999, *Opt Lett.* **24**, 652.
- [4] N.Kokanyan, D.Chapron, E.Kokanyan, M.D.Fontana 2017, *J. of Appl. Phys.* **121**, 095103.
- [5] M. Nippus and R. Claus, *Z. Naturforsch* 1978, Teil A **33**, 924.
- [6] M.D.Fontana and P.Bourson 2015, *Appl. Phys. Rev.* **2**, 040602.
- [7] M.Bazzan, N.Kokanyan, A.Zaltron, N.Argiolas, D.Chapron, M.D.Fontana 2013, *J. of Appl. Phys.* **114**, 163506.
- [8] D W Wilson, E N Glytsis, N F Hartman and T K Gaylord 1992, *J. Opt. Soc. Am. B*, **9**, 1714