OFF-AXIS CONFIGURATION OF F_A(Li) CENTRES IN KF

A. Scacco, F. Somma, M. Rossi, F. De Matteis, Dipartimento di Fisica, Università *La Sapienza*, P.le A. Moro 2, 00185 Roma, Italy

G. Baldacchini, ENEA, Dip.TIB, U.S. Fisica Applicata, CRE Frascati, C.P.65, 00044 Frascati, Italy

U.M. Grassano, Dipartimento di Fisica, Università di Roma-Tor Vergata, V. O. Raimondo, 00173 Roma, Italy

Abstract: The off-axis configuration of F_A dipoles was identified in KF:Li^+. The centre tilt from the crystal axis is, as expected, larger in KF:Li^+ than in KCl:Li^+ and in RbCl:Li^+.

1.Introduction

The off-centre displacement of Li^+ ions in crystals of alkali halides, showing a sufficiently large lattice parameter, was experimentally observed in KCl [1] and in RbCl [2], and theoretically calculated for several systems [3]. Such a peculiar configuration of the isolated impurity seems to be correlated in the above systems to a tilt from the crystal axis of the F_A dipole, formed by association of the impurity ion with a nearest-neighbour anion vacancy trapping an electron. The off-axis deviation of the F_A(Li) centres was quantitatively determined both in KCl:Li^+ [4] and RbCl:Li^+ [5] by means of optical measurements. In this work the investigation on the configuration of F_A(Li) dipoles is extended to KF:Li^+.

2. Experimental results and discussion

The technique used for studying the off-axis geometry of the F_A(Li) centres is the analysis of their photostimulated reorientation under polarized optical pumping into the range of the F_A absorption [6]. The alignment process was theoretically treated, by taking into account both the off-axis effect of the dipoles and the overlap of the two F_A absorption bands, for experiments in equilibrium conditions [4] or during transient phenomena [7].

In KF:Li^+ preliminary absorption measurements have been performed on transient effects. After thorough orientation of the centres by irradiation with monochromatic F_A light polarized along one of the cyrstal axes, the polarization plane of the incident beam was suddenly rotated: as a consequence, a depopulation occurs for centres lying parallel to the above direction, while the centre population along perpendicular directions increases correspondingly. The initial absorption $\alpha(0)$ and the steady-state absorption $\alpha(\infty)$, measured for two different rotations of the polarization plane of the exciting light (Figure 1),

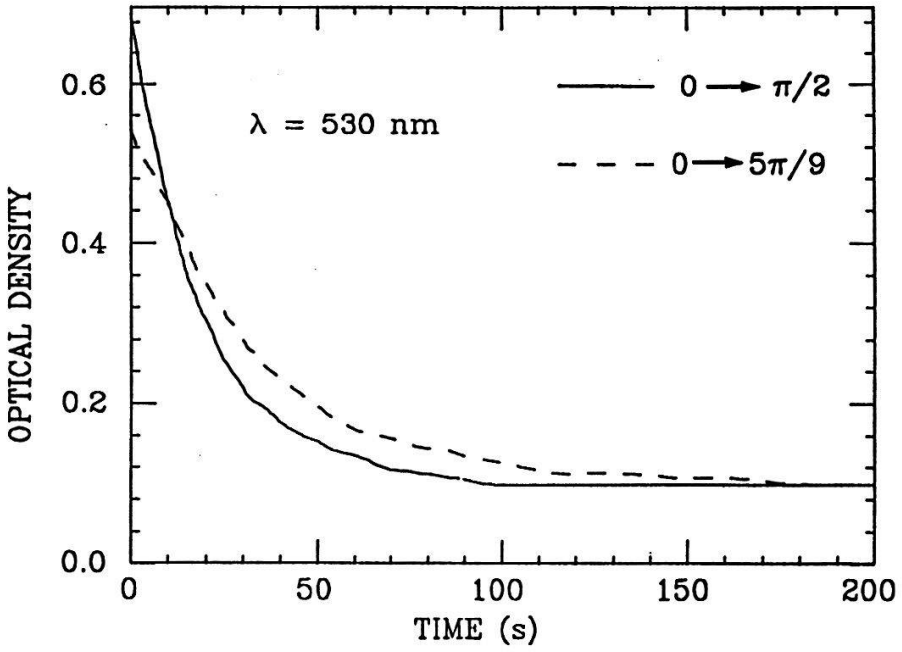

Figure 1: *Kinetics of the $F_A(Li)$ centre photostimulated reorientation in KF:Li^+ at 77 K.*

allow the calculation of both the off-axis angle θ of the F_A dipoles and the ratio R of the cross sections related to the two F_A transitions.

From these and other results, obtained at various wavelengths of the pumping light, it is possible to deduce a first approximate evaluation of θ in KF:Li^+, which is slightly bigger than 10°. Such value, to be confirmed by luminescence experiments at various temperatures, is larger than those in KCl:Li^+ and in RbCl:Li^+, as expected because of the more pronounced displacement of the isolated Li^+ ion in this system [3].

3, References

[1] F. Rosenberger and F. Lüty, Solid State Commun. 7, 983 (1969).

[2] K. Thörmer and F. Lüty, Phys. Status Solidi (b) 90, 277 (1978).

[3] C.R.A. Catlow, K.M. Diller, N.J. Norgett, J. Corish, B.M.C. Parker, and P.W.M. Jacobs, Phys. Rev. B 18, 2739 (1978).

[4] G. Baldacchini, K. Somaiah, U.M. Grassano, A. Scacco, and F. Somma, Il Nuovo Cimento 9D, 1105 (1987).

[5] G. Baldacchini, F. De Matteis, E. Giovenale, A. Scacco, F. Somma, and U.M. Grassano, Phys. Rev. B 37, 7014 (1988).

[6] F. Lüty, in Physics of Color Centers, ed. W.B. Fowler (Academic, New York, 1968), Chap. 3.

[7] G. Baldacchini, U.M. Grassano, A. Scacco, and F. Somma, Phys. Scripta 37, 381 (1988).