# ON CONTRAST REVERSAL OF STORED IMAGES IN ALKALI HALIDE CRYSTALS CONTAINING ANISOTROPIC COLOUR CENTERS

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ABSTRACT

It is demonstrated that, from the image information stored in alkalide crystals (*e.g.*, Potassium chloride) containing anisotropic colour centers such as M-centers, contrast Reversed Image (CRI) could be retrieved by employing the extinction technique.

## INTRODUCTION

ALKALI halide crystals containing anisotropic color centers such as M-centers have been used extensively as reusable materials for optical data storage[1-5] and essentially two methods are in vogue for the storage (read out) of information in such recording media. In the first method the stored information is related to the deviations from an initial state of total M-center alignment. The second method involves, in so far as storage is concerned, deviations from an initial state in which M-centers are aligned in equal concentrations along the ⟨110⟩ directions of the crystal. In both the methods information could be written (or erased) using linearly polarised $M_F$ light and read nondestructively using linearly polarised M-band light. In the second method sensitive detection of information is possible by placing the crystal between properly oriented crossed polarisers. Such a readout technique is known as Extinction Technique and it yields high contrast images as opposed to the first method[6].

The purpose of this note is to demonstrate experimentally *a new fact* that contrast reversed images (CRI) could also be obtained using the Extinction Technique.

## EXPERIMENTAL

A freshly cleaved additively colored KCl crystal having an F-center concentration of about $10^{17}$ centers/$cm^3$ is irradiated at room temperature with light of wavelength $\lambda = 514 \cdot 5$ nm, obtained from a Coherent Radiation Model-52 Argon-Ion laser, in order to produce M-centers. During irradiation the orientation of the crystal is chosen such that the vertically polarised irradiating laser beam corresponds to [001] direction of the crystal and as a consequence, equal concentrations of M-centers are obtained along [011] and [0$\bar{1}$1] directions of the crystal. Image information from a transparency is transferred on to such a crystal by using a recording set-up shown in Fig. 1. During recording the direction of polarisation of the 'write' light (*viz.*, 514·5 nm line of Argon-Ion laser) is adjusted to lie along [011] direction using a half wave plate and the crystal is exposed for a few seconds. As a consequence of this operation, the M-centers in the crystal contained in regions corresponding to the transmitting portions of the object transparency have been preferentially aligned along [011] direction and in the regions corresponding to the opaque portions of the object, the M-centers will remain in their initial state of alignment. Extinction Technique is employed for readout (Fig. 2) and the same Argon-Ion laser wavelength is used for this purpose. The intensity of the beam is kept sufficiently low to avoid erasure during readout. The crystal is maintained at room temperature during recording and readout.

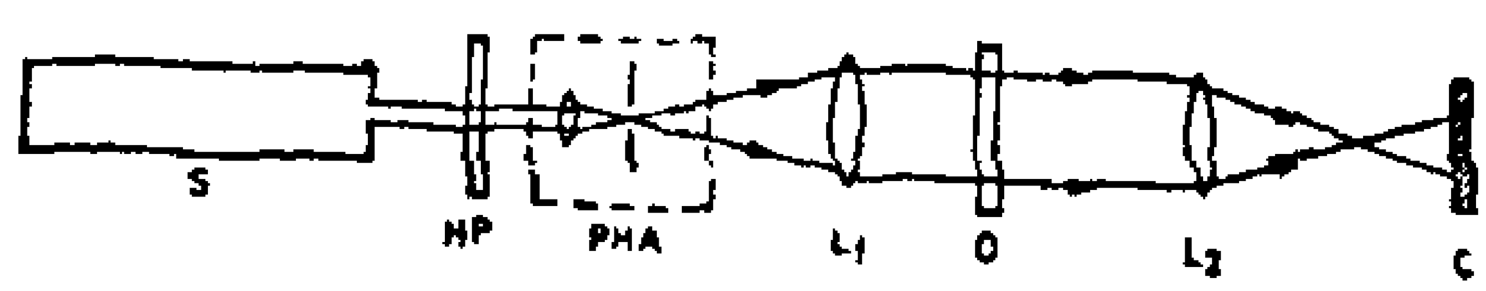


FIG. 1

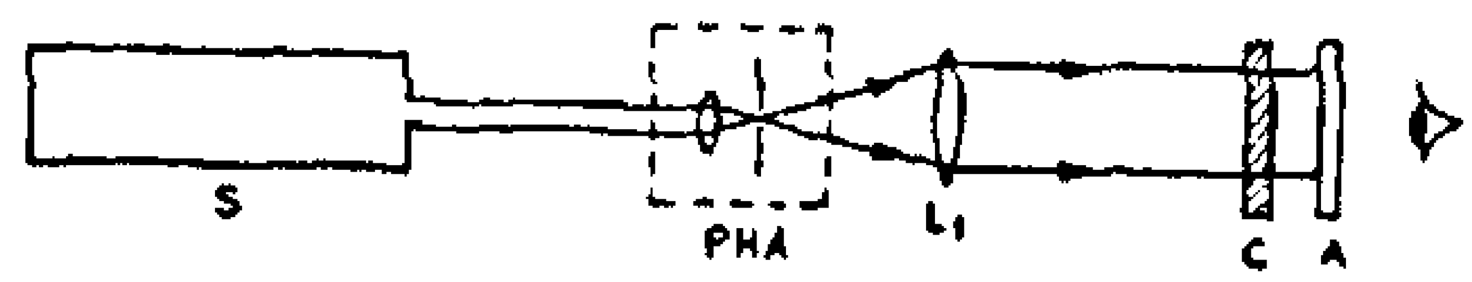


FIG. 2

FIGS. 1 and 2. Schematic diagrams of the experimental arrangements used for recording and readout respectively. S-Argon-Ion laser which puts out vertically polarised light. HP—Half wave plate, PHA—Pin hole spatial filter assembly, $L_1$—Collimating lens, $L_2$—Imaging lens, O—object transparency, C—crystal, A—Analyser.

## RESULTS AND DISCUSSION

During readout, using Extinction Technique, when the analyser is in perfectly crossed position with respect to the incident polarised light, the image obtained is observed to be a replica of the original object in so far as its contrast variation is concerned [Fig. 3 (*a*) and (*b*)]. This result isc onsistent with the observation of earlier workers[6]. In addition we have observed that contrast reversed image [Fig. 3 (*c*)] could be obtained by slightly rotating the analyser from the crossed position by about two degrees. The direction of

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(*a*) (*b*) (*c*)

FIG. 3. Photographs of (*a*) Object used for recording,. (*b*) Reconstructed image obtained when the anayser is in perfectly crossed position, (*c*) Reconstructed image obtained when the analyser is slightly rotated. *In this case the image possesses contrast variation which is the reverse of the image given under,* (*b*) for reasons given in the text.

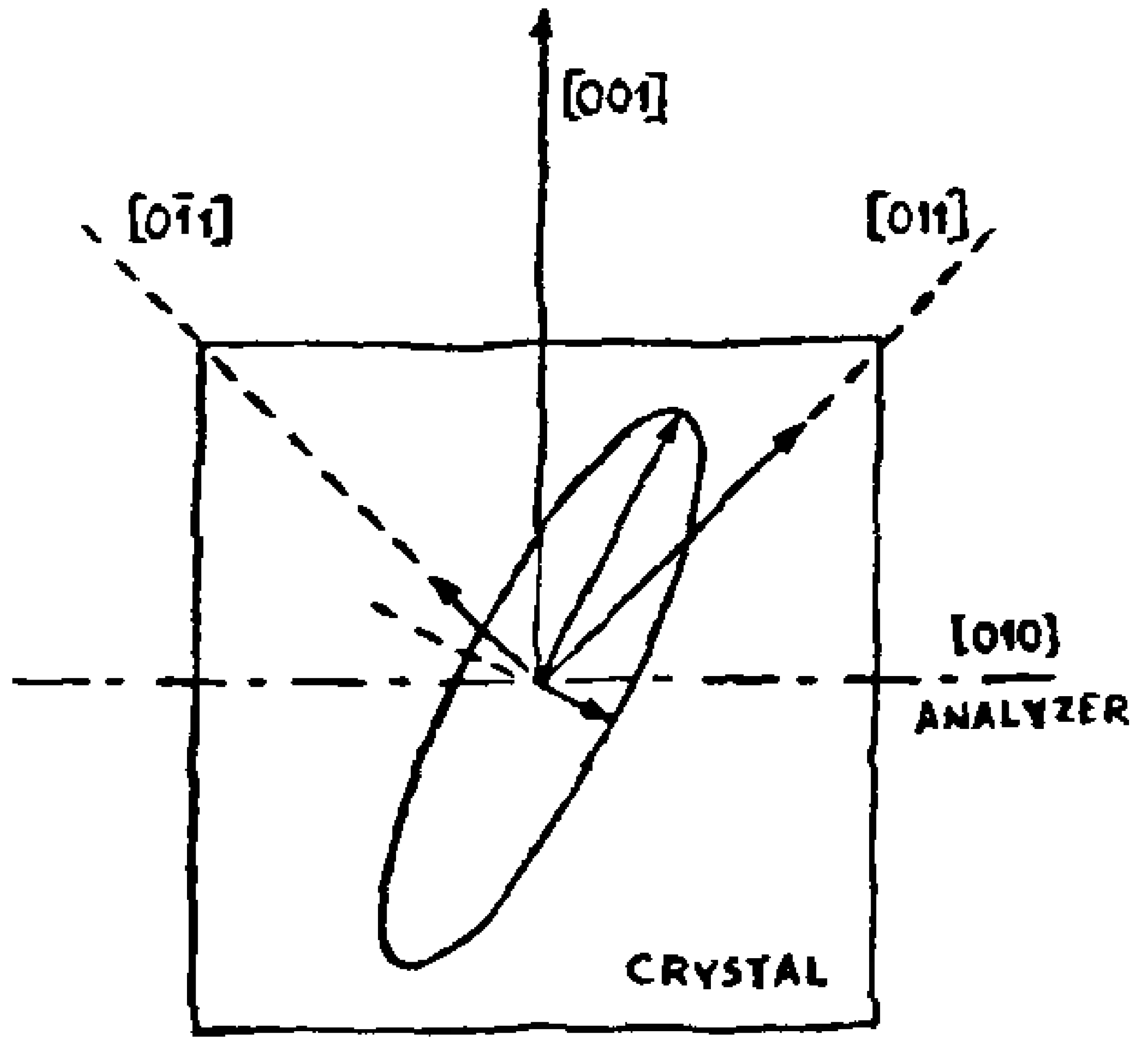


FIG. 4. Schematic diagram for explaining the phenomenon of Contrast Reversal of the retrieved image.

this rotation of the analyser should be clock-wise if the centers are preferentially aligned along [011] and anti-clockwise if they are aligned along [01̄1]. The observed new phenomenon of contrast reversal can be explained as follows with the aid of the schematic diagram for the analysis of light transmitted by the analyser shown in Fig. 4. When the analyser is in perfectly crossed position it absorbs all the background light which retains the state of polarisation of the light incident on the crystal; whereas the light passing through the crystal in the regions of preferential alignment comes out elliptically polarised and hence it is transmitted by the analyser. Therefore the retrieved image will possess the same contrast variation as the object used for recording. When the analyser is rotated by about two degrees in a suitable direction, depending on the direction of alignment of centers as already mentioned, it is brought into the direction of minor axis of the ellipse wherein the light transmitted by the analyser is least (for elliptically polarised light) but at the same time more background light is transmitted by the analyser and hence the effect of contrast reversal can be observed.

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# ON THE SHAPES OF THE COMPLEX PLANE POLAROGRAMS

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ABSTRACT

Complex plane polarograms have been obtained for Co(III)-EDTA, Cu(II)-EDTA, Cu(II)-CyDTA and *m*-dinitrobenzene systems. The shape of complex plane polarograms for each system is different in some respects from that of other systems. Various factors affecting the shapes, *viz.*, frequency of measurement, reversibility of electrode processes and weak adsorption, have been discussed in detail.

## INTRODUCTION

THE name "Complex Plane Polarograms" has come into existance in recent years after the work of Sluyters[1] on impedance analyses of electrochemical reactions. According to this method impedance data are plotted on a complex impedance plane having the quadrature component as Y axis and in-phase component as X axis with variation in one of the variables