Analysis of Photorefractive BTO crystal using Jones Matrix

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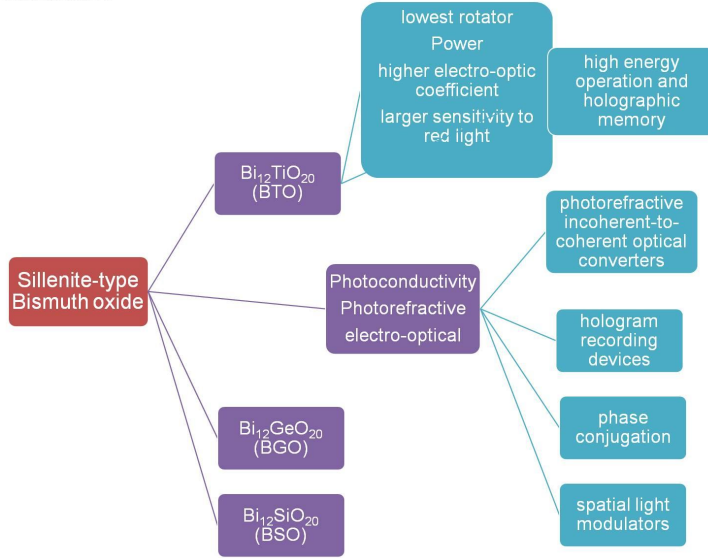[1] Department of Physics, Indian Institute of Technology, Delhi, India

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Abstract: We present a double shot interferometric polarimetry approach to measure Jones matrix of BTO crystal. This method is fast, simple yet effective and useful to characterize and analyze the polarization modulation induced by photorefractive Bismuth Titanyl Oxide (BTO) crystal.

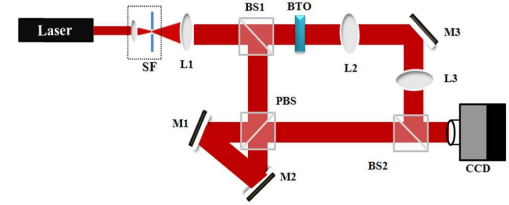## Introduction

Results and Conclusion

Fig 1 Experimental Setup for measuring Jones Matrix of BTO crystal
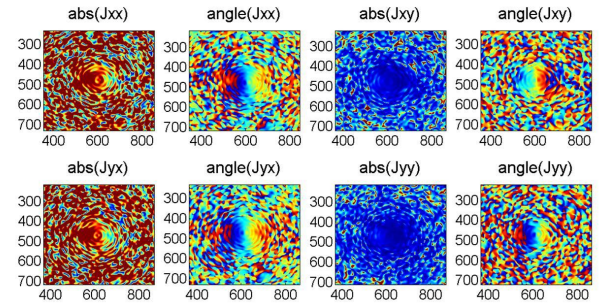

Fig 2 : Modulated output electric field Jones Matrix elements

To measure Jones matrix, the proposed method uses two recordings of interference pattern formed by the light that passes through the crystal with the reference beam polarized at $+45^0$ and -45^0 respectively. These two images are then used by the derived equations for the extraction of Jones Matrix. Therefore, with the purposed method, we are able to record all four Jones elements in a two shots. Fig.2 shows the amplitude and phase of the Jones components of the BTO crystal. Jones elements value can be further utilized to calculate the polarization state of output electric field, which will help us to maximize the crystal efficiency to use it in any of the mentioned applications.

Principle

incident coherent light Jones vector

$$U = \begin{bmatrix} U_x \\ U_y \end{bmatrix} \qquad E = \begin{bmatrix} E_x \\ E_y \end{bmatrix}$$

and output Jones vector

And are related as

$$\begin{bmatrix} E_x \\ E_y \end{bmatrix} = \begin{bmatrix} J_{xx} & J_{xy} \\ J_{yx} & J_{yy} \end{bmatrix} \times \begin{bmatrix} U_x \\ U_y \end{bmatrix}$$

For $+45^0$ input polarized light ,
$$E_x^+ = J_{xx} + J_{xy} \qquad E_y^+ = J_{yx} + J_{yy}$$

For -45^0 input polarized light ,
$$E_x^- = J_{xx} - J_{xy} \qquad E_y^- = J_{yx} - J_{yy}$$

From the four equations above, Jones matrix elements of the BTO crystal can be derived

$$J_{xx} = \frac{1}{2}\left(E_x^+ + E_x^-\right) \qquad J_{xy} = \frac{1}{2}\left(E_x^+ - E_x^-\right)$$

$$J_{yx} = \frac{1}{2}\left(E_y^+ + E_y^-\right) \qquad J_{yy} = \frac{1}{2}\left(E_y^+ - E_y^-\right)$$

References

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