Laser Conoscopy of Two-component Optical Systems from Gyrotropic Crystals

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The experimental results of laser conoscopic studies of systems of two optically active crystal plates (TeO_2, $LiJO_3$) with the optical axis is perpendicular to the face of plate are presented in this paper. When aligned with the axis of the optical system, a single conoscopic pattern is observed on the screen, which looks like rings-isochromes with a "Maltese cross" on the periphery, if the rotation signs of both plates coincide; in the opposite case, a four-way spiral appears on the screen, whose branches are twisted in the direction of rotation of the vector E for the plate closest to the screen (to the left or to the right).

By setting the angle between the optical axes of the plates and the system axis within 4° to 14°, either two conoscopic patterns are observed on the screen if the optical signs of the plates do not coincide, or three conoscopic patterns including an additional ring structure if the optical signs of both plates coincide. The observation of an additional ring system is explained by calculations of the phase difference between the ordinary and extraordinary beams, and the periodic change of intensity at the center of the structure requires additional study.

It should be noted an important property of the proposed two-component optical systems is the possibility of getting require phase shift by setting the angle between the optical axes of the crystal plates without using expensive phase elements and technological costs.

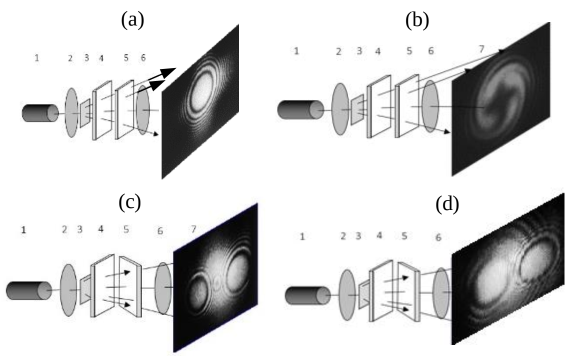

Fig. 1. The schematic of optical system for laser conoscopy of a system of two gyrotropic crystal elements. 1- laser; 2 - polarizer; 3 - scatter; 4,5 - crystal elements; 6 - analizer; 7 - screen. (a), (b) - crystal plates are installed coaxially ((a) - both plates have the same sign of rotation of the radiation polarization plane; (b) - plates have the opposite sign of rotation); (c), (d) - crystal plates are instaled with some angle between optical axes ((c) - plates have the same optical sign; (d) - plates have different optical sign).

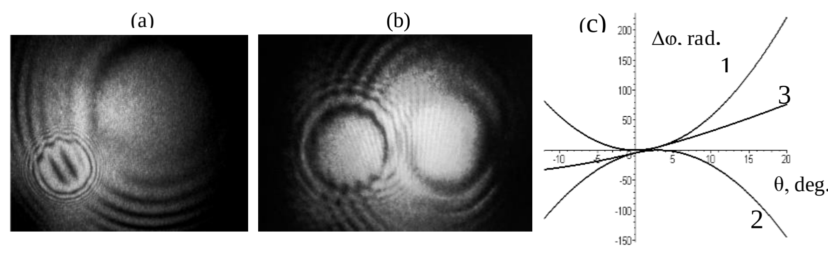

Fig. 2. (a), (b) - conoscopic patterns photos of two crystal plates system with different optical sign (paratellurite with positive optical sign and lithium iodate with negative optical sign) located at an angle to each other; (c) - dependences of the phase difference between ordinary and extraordinary beam on the angle of radiation incidence*:* 1 - normally oriented plate of TeO_2 7 mm thick; 2 - plate of $LiJO_3$ 10 mm thick oriented at an angle of 4° to the axis of the system; 3 - two plates with an angle of 4° between them.

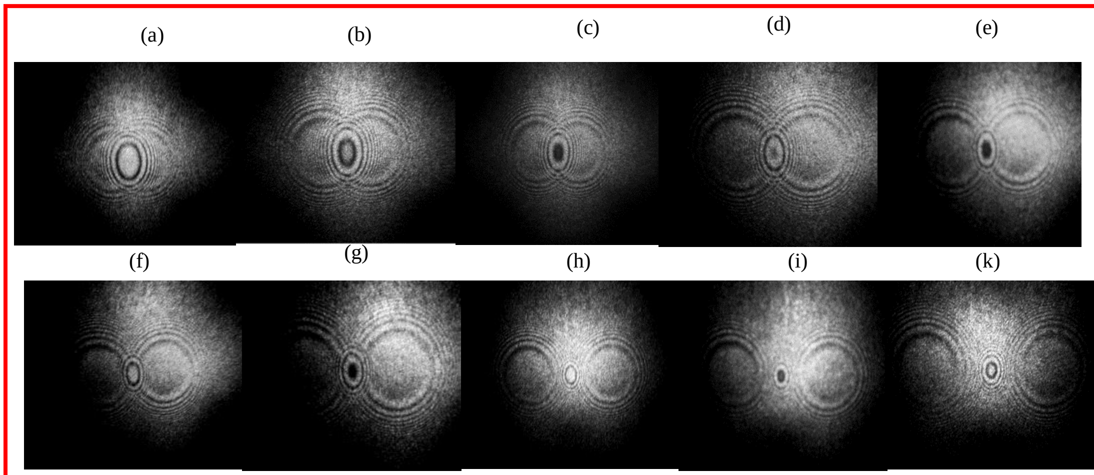

Fig. 3. Conoscopic patterns of two $LiJO_3$ crystal plates system with the same optical sign (negative optical sign) with a thickness in the direction of the optical axis of 33 mm and 37 mm.
The angle between plates optical axes, deg: (a) - 1, (b) - 2, (c) - 3, (d) - 4, (e) - 5, (f) - 6, (g) - 7, (h) - 8, (i) - 9, (k) - 10.

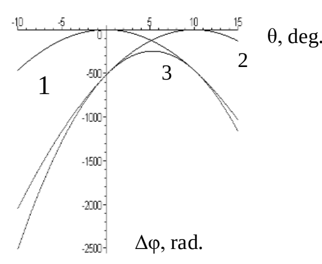

Fig. 4. Dependence of the phase difference between ordinary and extraordinary beams on the angle of incidence of radiation: 1 - normally oriented $LiJO_3$ plate with a thickness of 33 mm; 2 - $LiJO_3$ plate with a thickness of 37 mm oriented at an angle of 10° to the system axis; 3 - two $LiJO_3$ plates with an angle of 10° between them.