UNIT CELL PARAMETERS, SPACE-GROUP AND OPTICAL PROPERTIES OF COBALT NITRATE HEXAHYDRATE

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(*Memoir No.* 106 *from the Raman Research Institute, Bangalore-6*)

Received February 24, 1958

Cobalt nitrate hexahydrate crystallises from aqueous solution as large platy crystals which are highly deliquescent. According to Groth the crystal belongs to the monoclinic system with axial ratios $a:b:c::1\cdot172:1:1\cdot925$ and $\beta = 101°$. The density is given as $1\cdot88$ gm./c.c. In a previous paper in these *Proceedings* (1957, **45,** 263), the unit cell parameters and optical properties of nickel nitrate hexahydrate were reported. In the same connection it was thought worthwhile to investigate the structure and optical properties of cobalt nitrate hexahydrate. In the present communication the unit cell parameters, space-group and optical properties of the crystal are reported.

Cobalt nitrate hyxahydrate was crystallised by making a saturated solution and allowing the same to crystallise in an air-tight enclosure containing anhydrous calcium chloride in a dish. Large platy crystals reddish orange in colour were obtained in this manner, which were dried between filter-papers and kept immersed in kerosene. Examination of one of the plates under the polarising microscope exhibited straight extinction. The crystal was mounted on the Federov stage, with kerosene as the immersion medium and rotated about the straight extinction edge as the axis. The crystal continued to remain extinguished and exhibited a biaxial figure when examined in convergent polarised light.

For X-ray work, a thin rod-shaped piece ground parallel to the straight extinction edge was employed, and this was enclosed in a thin-walled glass capillary tube sealed at one end and blocked at the other with wax. Since the crystal is highly deliquescent, it had to be protected from attack by moisture during X-ray exposure in the above manner.

One rotation, and three Weissenberg photographs were taken with the crystal rotated about the axis chosen, employing NiKα radiation. The three

Weissenberg photographs were respectively, the zero, first and second layer photographs. A perusal of the rotation and zero layer Weissenberg photographs revealed that the axis of rotation was the *b*-axis of a crystal belonging to the monoclinic system. One more rotation and zero layer Weissenberg photograph was recorded rotating the crystal about another crystallographic axis, perpendicular to the *b*-axis. Axial dimensions were calculated from rotation and Weissenberg photographs and are as follows:

$$a = 15{\cdot}09 \text{ AU}$$

$$b = 6{\cdot}12 \text{ AU} \qquad \beta = 119°$$

$$c = 12{\cdot}69 \text{ AU}$$

From the measured density of 1·9 and the calculated volume on the basis of the above dimensions, the number of molecules per unit cell turns out to be 4.

The Weissenberg photographs were indexed and the following conditions for the presence of reflections were noted.

$$hkl : h + k = 2n$$

$$hol : l = 2n \; ; (h = 2n)$$

$$oko : k = 2n$$

On looking up the *International Tables*, the monoclinic space-groups C/*c* and C2/*c* satisfy these conditions. Of these two, C/*c* has no centre of symmetry. Optical examination did not reveal the presence of optical activity, the brush crossing the eye being quite definitely dark. It is highly probable that the crystal belongs to the monoclinic space-group C2/*c*. Complete structure determination is under progress.

OPTICAL PROPERTIES

The convergent light figure is observed on the habit plane which corresponds to the ($\bar{1}01$) face of the crystal, when referred to the axes chosen on the basis of the X-ray results. The principal vibration direction parallel to the *b*-crystallographic axis is found to be the intermediate or β index of refraction. The orientation of the optical elements are shown in Fig. 1.

The refractive indices for sodium light were measured by employing the immersion method with a polarising microscope and an universal stage. The values determined are as follows:

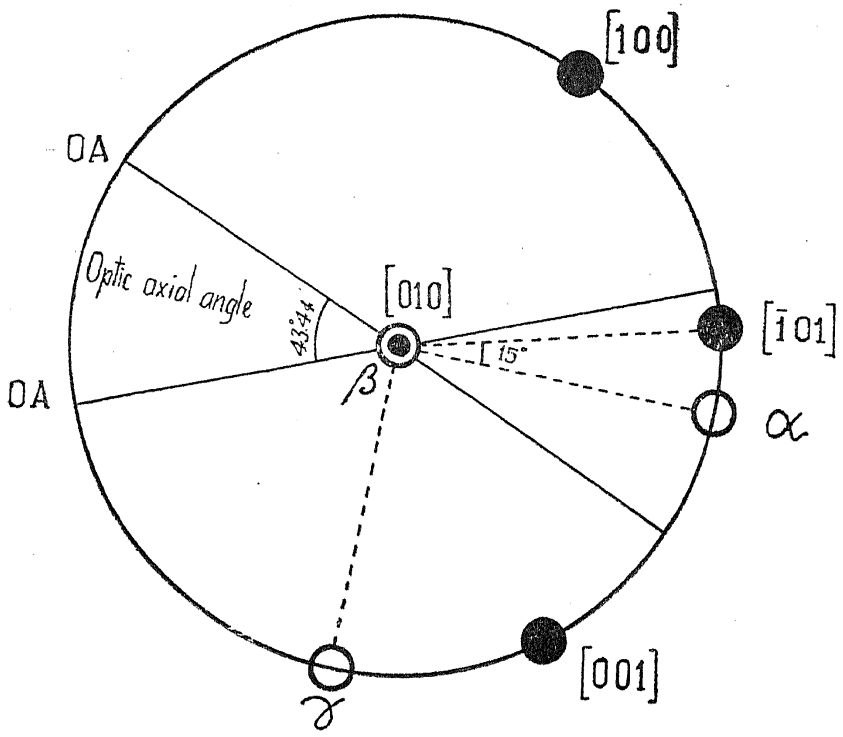

FIG. 1

$\alpha = 1{\cdot}38$

$\beta = 1{\cdot}52$ $\quad 2V = 43° 44'$

$\gamma = 1{\cdot}547$

The crystal is biaxial negative.

Pleochroism is not marked for the vibration direction parallel to β and γ. But for a vibration parallel to α and γ the effect is very vivid. For the former the colour is purple and for the latter it is orange yellow.

The author in conclusion wishes to express his thanks to Professor Sir C. V. Raman for his interest in the investigation.