Crystallographic Angles for Manganese Bismuthide

by W. J. Romanow

RECENT papers by Williams, Sherwood, and Boothby,¹ Seybolt et al.,² Heikes,³ and Roberts⁴ attest to the increasing importance of the hexagonal ferromagnetic compound MnBi. Since the magnetic properties of MnBi crystals are highly anisotropic, it is useful and necessary to have appropriate aids for determining their orientations—a (00·1) standard stereographic projection and a corresponding table of crystallographic angles for this structure. The tables of crystallographic angles for the hexagonal system available in the literature⁵ are computed for c/a ratios greater than that of MnBi and cannot satisfactorily be used to find the crystallographic angles of MnBi.

A table of angles between the crystallographic planes ($HK\cdot L$) and ($hk\cdot l$) was calculated for MnBi from the formula⁶

$$\phi = \arccos \frac{Hh + Kk + \frac{1}{2}(Hk + hK) + \frac{3}{4}(a/c)^2 Ll}{\sqrt{(H^2 + K^2 + HK + \frac{3}{4}(a/c)^2 L^2)(h^2 + k^2 + hk + \frac{3}{4}(a/c)^2 l^2)}}$$

on an IBM Type 650 Magnetic Drum Data Processing machine. The lattice constants used are listed in

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Table I. Angles Between the Crystallographic Planes of Manganese Bismuthide*

$HK\cdot L$	$hk\cdot l$	ϕ
00·1	10·8	11.64
	10·7	13.25
	10·6	15.36
	10·5	18.24
	10·4	22.39
	20·7	25.21
	10·3	28.78
	20·5	33.39
	10·2	39.48
	20·3	47.69
	10·1	58.75
	20·1	73.12
	10·0	90.00
	21·2	65.36
	21·1	77.08
	21·0	90.00
	11·8	19.63
	11·6	25.44
10·0	11·4	35.51
	11·2	54.98
	11·0	90.00
	12·2	65.36
11·0	12·1	77.08
	12·0	90.00
	21·0	19.11
	11·0	30.00
11·0	12·0	40.89
	01·0	60.00
	12·0	10.89
	12·0	60.00

* $a_0 = 4.286\text{\AA}$, $c_0 = 6.116\text{\AA}$, and $c/a = 1.427$.

Table I and are those determined by Willis and Rooksby⁷ at 20°C. More recently published values obtained by both X-ray and neutron diffraction^{2,4} show no difference from these significant to the calculation.

From the crystallographic angles between the basal plane (00·1) and the general plane ($hk\cdot l$) in Table I, an (00·1) standard stereographic projection was made for MnBi which is shown in Fig. 1.

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Fig. 1—Standard (00.1) stereographic projection for MnBi; $c/a = 1.427$.