

and equation (1) reduces to

$$B_{\mathbf{h}}^{\text{n.s.}} = \frac{|F_{\mathbf{h}}|^2 - |F_{-\mathbf{h}}|^2}{4f_a''} \quad (5)$$

The criteria for optimum wavelengths for phase determination are found in the denominators of equations (4) and (5); first, that one radiation gives a large value of the out-of-phase component f_a'' , for one or more atoms, which will give a large difference in the observed reflections $F_{\mathbf{h}}^2$ and $F_{-\mathbf{h}}^2$; secondly, that the difference of the in-phase components of anomalous scattering for the two radiations, $(\Delta f_{a\lambda_1}' - \Delta f_{a\lambda_2}')$, be as large as possible to produce a large difference in the observed mean square values $\mathcal{F}_{\mathbf{h}\lambda_1}^2$ and $\mathcal{F}_{\mathbf{h}\lambda_2}^2$.

The accuracy of the method is dependent upon an exact knowledge of the anomalous scattering increments

$\Delta f'$ and f'' to the atomic scattering factor. The table of these values calculated by Dauben & Templeton (1955) for $Z \geq 20$ is for three radiations Cr $K\alpha$, Cu $K\alpha$ and Mo $K\alpha$ only. Values for intermediate radiations can be estimated by interpolation, but for general application of this method of calculation of exact values, or their experimental measurement, a full range of radiations would be of great assistance.

References

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The crystal structures of thorium bismuthides. By RICCARDO FERRO, *Chemical Institute, Laboratory of Physical Chemistry of Genoa University, Genoa, Italy*

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The diagram of the thorium-bismuth alloys, obtained *in vacuo* by direct synthesis from the elements, has been studied by means of X-rays; the examination was performed by the powder method using Cu $K\alpha$ radiation ($\lambda(\text{Cu } K\alpha_1) = 1.540500 \text{ \AA}$). The only impurity in the thorium used (prepared by reduction of ThO_2 with Ca) was about 0.3% oxygen, mainly as ThO_2 ; the bismuth had a purity higher than 99.9%, with traces of lead.

In the part of the diagram richer in bismuth the alloys show the existence of the compounds Th_3Bi_4 and ThBi_2 . No other compounds having higher quantities of bismuth have been observed, as alloys of a composition of around 80% Bi (both quenched from 1000° C. or annealed up to 400° C.) showed only the Debye reflexions of ThBi_2 and elementary bismuth.

The X-ray examination of the central part of the diagram shows the possible existence of two phases of a composition near to ThBi ; however, it was not possible (with several thermal treatments, including also annealing and heating to higher temperatures) to obtain a cubic phase of the NaCl- or CsCl-type, as might expected by comparison with similar systems of thorium and uranium with other metalloids. With regard to these alloys it must be remarked that, if heated *in vacuo* at approximately 1500° C., they undergo alteration by bismuth distillation.

Finally, the alloys with a low bismuth content have not shown (after heating at a high temperature and cooling) the formation of other compounds: samples which on analysis had a composition around 30% Bi show mainly the reflexions of elementary thorium.

As with bismuth and the intermediary phases, the photographs exclude the formation of appreciable solid solution for thorium. All the alloys are fairly pyrophoric.

Th_3Bi_4

The compound Th_3Bi_4 (45.44% Th) is body-centred cubic with

$$a_0 = 9.559 \text{ \AA}, Z = 4, \rho = 11.65 \text{ g.cm.}^{-3}.$$

The structure is of the Th_3P_4 type (Meisel, 1939), D_{7h} type (*Strukturbericht*, 1943) with:

Space group No. 220 (*International Tables*, 1952): $I\bar{4}3d$.

Atomic positions:

$$\begin{aligned} 12 \text{ Th} & \text{ in } (a) \left(0, 0, 0; \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) + \frac{3}{8}, 0, \frac{1}{4}; \text{C} \\ 16 \text{ Bi} & \text{ in } (c) \left(0, 0, 0; \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) + x, x, x; \\ & \text{C with } x = \frac{1}{12}. \end{aligned}$$

Each thorium atom is thus bound to 8 bismuth atoms at the distance of 3.32 Å.

ThBi_2

The compound ThBi_2 (35.70% Th) is tetragonal with

$$\begin{aligned} a_1 = 4.492, a_3 = 9.298 \text{ \AA}, a_3/a_1 = 2.070, Z = 2, \\ \rho = 11.50 \text{ g.cm.}^{-3}. \end{aligned}$$

The structure corresponds to the C38 type (*Strukturbericht*, 1937) with:

Space group No. 129 (*International Tables*, 1952): $P4/nmm$.

Atomic positions:

$$\begin{aligned} 2 \text{ Bi}_I & \text{ in } (a) \ 0, 0, 0; \frac{1}{2}, \frac{1}{2}, 0. \\ 2 \text{ Bi}_{II} & \text{ in } (c) \ 0, \frac{1}{2}, x; \frac{1}{2}, 0, \bar{x} \text{ with } x = 0.63. \\ 2 \text{ Th} & \text{ in } (c) \ 0, \frac{1}{2}, t; \frac{1}{2}, 0, \bar{t} \text{ with } t = 0.28. \end{aligned}$$

The Th-Bi distances are:

Th-4 Bi_I = 3.44; Th-1 Bi_{II} = 3.26; Th-4 Bi_{II} = 3.29 Å.

The smallest Bi-Bi distance is Bi_I-4 Bi_I = 3.18 Å.

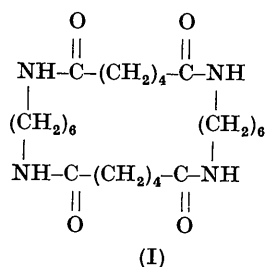
The above mentioned compounds are isostructural with both U₃Bi₄ and UBi₂ (Ferro, 1952, 1953) and with Th₃As₄, ThAs₂ (Ferro, 1955) and Th₃Sb₄, ThSb₂ (Ferro, 1956) previously studied.

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Elementarzelle des cyclischen Nylon-Oligomeren 1,8,15,22-tetra-aza-2,7,16,21-tetra-oxo-cyclo-octacosan. Von HANS VON DIETRICH, HELMUT ZAHN* und FRANZ SCHMIDT, *Chemisches Institut der Universität Heidelberg, Deutschland*

(Eingegangen am 11. März 1957)

Das aus Nylon 66 isolierbare cyclische Oligomere (I)



kristallisiert aus Wasser in monoklinen Blättchen (Zahn *et al.*, 1956a; Brown, Hill & Youle, 1956; Zahn, Miro & Schmidt, 1957); Blättchenebene (010), Spaltbarkeit nach (001) angedeutet.

Die röntgenographische Untersuchung ergab folgende Daten:

* Gegenwärtige Adresse: Deutsches Wollforschungsinstitut an der Rheinisch-Westfälischen technischen Hochschule, Aachen, Deutschland.

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A graphical method for the calculation of $|F|^2$ and $|F|$ from equi-inclination Weissenberg photographs. By KURT BOSTRÖM, *Department of Mineralogy, Swedish Museum of Natural History, Stockholm 50, Sweden*

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Introduction

In a given Weissenberg equi-inclination photograph the intensities of the spots obey the equation

$$I = C \cdot \lambda^3 \cdot A \frac{1 + \cos^2 2\theta}{\cos^2 \mu \sin \gamma} \cdot |F|^2 \quad (1)$$

if the extinction is not taken into consideration. Here C is constant and A an absorption factor. The other symbols are identical with those used by Buerger (1942).

We can write (1) in the following way:

References

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 MEISEL, K. (1939). *Z. anorg. Chem.* **240**, 300.
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$$a_0 = 10,78 \pm 0,03, \quad b_0 = 25,12 \pm 0,05, \quad c_0 = 9,67 \pm 0,02 \text{ \AA}, \\ \beta = 92^\circ 22' \pm 6'.$$

Nimmt man an, dass die Zelle vier Moleküle enthält, so ergibt sich die Dichte = $1,149 \pm 0,005 \text{ g.cm.}^{-3}$ (bei $25-27^\circ \text{ C.}$). Gemessen wurde: $1,148 \text{ g.cm.}^{-3}$ (bei 28° C.).

Der aus Debye-Scherrer-Aufnahmen bestimmte Netzebenenabstand von 12,6 Å (Schmidt, 1956; Zahn *et al.*, 1956b), also gerade $\frac{1}{2}b_0$, lässt darauf schliessen, dass die Ausdehnung der Einzelmoleküle auch in Richtung der b -Achse höchstens 12,6 Å ist, was in Verbindung mit den übrigen Abmessungen der Elementarzelle eine starke Faltung der Ringe fordert. Bei völliger Streckung der Einzelmoleküle haben diese eine Länge von ca. 20 Å.

Referenzen

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$$|F|^2 = \frac{I}{C \cdot \lambda^3 \cdot A} \cdot \frac{\cos^2 \mu \cdot \sin \gamma}{1 + \cos^2 2\theta} \quad (2)$$

Lu (1943) introduced the abbreviation

$$\alpha = \frac{\cos^2 \mu \cdot \sin \gamma}{1 + \cos^2 2\theta} \quad (3)$$

If $C \cdot \lambda^3 \cdot A = 1$, equation (1) becomes

$$|F|^2 = I \cdot \alpha \quad (4)$$