

plane of the mineral is parallel to (100), $\alpha = c$, refractive indexes $\alpha = 1.5695$, $\beta = 1.5710$, $\gamma = 1.5775 \pm 0.0005$ (sodium light). The optic axial angle measured on the universal stage is $2V \ 41^\circ$ positive. Face-centred cells can be derived from the unit cells of banalsite and sanidine, which have similar dimensions, probably indicating the similarity of the silicon-aluminium-oxygen network in the two structures.

The banalsite occurs massive associated with tephroite, alleghanyite, jacobsite, baryte and calcite in certain rare veinlets and narrow bands in dark purple manganese ore. The tephroite and alleghanyite form thin blade-like crystals showing parallel intergrowths. The orientation of the crystals in these intergrowths and the chemical and X-ray study confirm A. F. Rogers's work³ on alleghanyite from North Carolina, which showed that alleghanyite is the manganese analogue of chondrodite, and that it bears the same relation to tephroite as chondrodite does to forsterite.

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¹ Russell, A., *Nature*, **36**, 180 (1911).

² Spencer, L. J., *Min. Mag.*, **26**, 231 (1942).

³ Rogers, A. F., *Amer. Min.*, **20**, 31 (1935).

α -Tungsten

In the course of an examination of the coatings formed on the tungsten electrodes of a spark gap and of a film sputtered from the electrodes on to the walls of a glass container, it has been found that both the coatings and the film contained a considerable proportion of α -tungsten in addition to normal body-centred cubic tungsten.

This observation is of interest since the only previously reported occurrence of α -tungsten is in the product from certain methods of electrolytic extraction^{1,2}. So far as is known, these are not in commercial use, and the tungsten electrodes themselves did not contain any of the α -form.

Identification was based on the X-ray diffraction pattern. The specimens gave sharp lines, and the cell size, absent spectra and the relative intensities observed for the permitted lines agreed with the published structure¹.

The lattice parameter, measured in a 19-cm.-diameter powder camera, was found to be 5.0408 ± 0.0002 kX. at 18° C., compared with the previously reported value of 5.038 ± 0.003 kX. at 20° C.³

Subsequent to this examination it was found that Mr. H. P. Rooksby had also made observations of certain occurrences of α -tungsten, and these form the subject of the accompanying communication.

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¹ Hartmann, Ebert and Bretschneider, *Z. anorg. Chem.*, **198**, 116 (1931).

² Burgers and Van Liempt, *Rev. Trav. Chim.*, **50**, 1051 (1931).

³ Neuburger, *Z. Krist.*, **85**, 232 (1933).

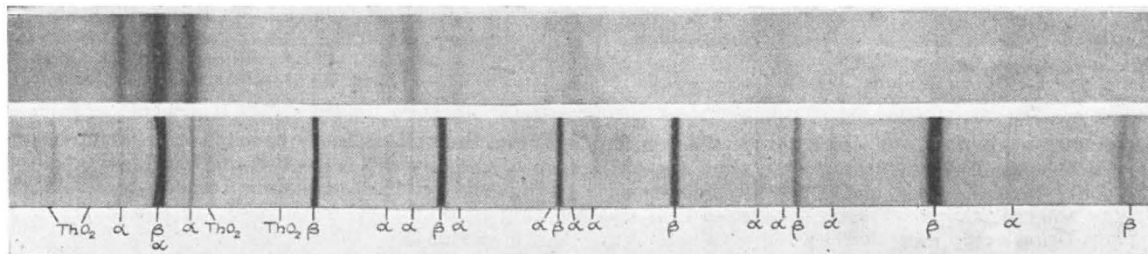
MR. N. J. PETCH has found that the α -form of tungsten occurs in sputtered films and deposits, whereas the only previously reported occurrence was in specimens prepared by electrolytic extraction.

We have also observed this second form of tungsten in the course of examination by X-ray methods of specimens of metallic tungsten from various sources. For example, α -tungsten is often the major constituent of films deposited on the glass envelopes of certain types of vacuum lamps, by evaporation from the tungsten filament. In some instances the α -form appears to be the sole constituent of the volatilized film, but in others it occurs mixed with the normal body-centred cubic form. Phosphorus is usually employed in the lamps that have been examined, for perfecting the vacuum conditions, and it is possible that this has some influence on the structure of the deposited tungsten. No definite evidence which would indicate the effect of the presence of phosphorus is, however, available at present.

Invariably the crystal size of the deposits is so small that the lines of an X-ray powder photograph are diffuse, but even so a sufficient number of reflexions are present for decisive identification of the α -phase. A typical powder photograph of an evaporated tungsten film consisting wholly of the α -phase is shown in the reproduction below.

We have also on occasion noticed the second form of tungsten in powders prepared by reduction of oxide in hydrogen. It has never been found in high concentration in such powders, and the exact conditions of reduction causing its retention have not been explored. But it does appear that impurities such as thoria have some influence. When small percentages of thoria (of the order of 1-2 per cent) are present, the α -phase has been detected in powders that have been reduced at as high a temperature as 800° C., whereas 650° C. has been given as the transition temperature for α -tungsten prepared by electrolytic processes.

The X-ray reflexions for the α -phase in reduced metal powders are sharp, and measurements of the lattice constant give 5.041 ± 0.0005 kX., in very



X-RAY POWDER PHOTOGRAPHS (COPPER $K\alpha$ -RADIATION, 19 CM. CAMERA) OF TUNGSTEN SPECIMENS. ABOVE, EVAPORATED FILM FROM TUNGSTEN FILAMENT VACUUM LAMP (α -TUNGSTEN); BELOW, TUNGSTEN POWDER PREPARED BY REDUCTION IN HYDROGEN OF OXIDE CONTAINING 2 PER CENT THORIA (MIXTURE OF β - AND α -TUNGSTEN).