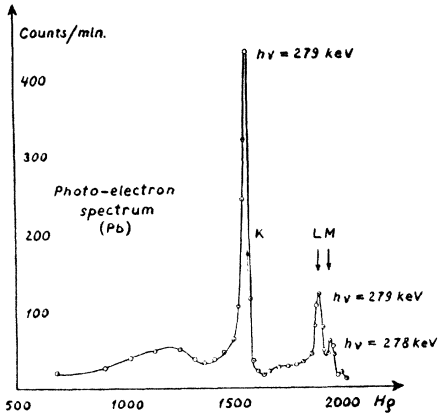

FIG. 3. Photoelectron spectrum from 3-μ Pb converter, released by the 279-kev Hg^{203} γ-ray.

γ-energy we can use $E_\gamma = 279 \pm 2$ kev. The corresponding value of Saxon is 286 ± 5 kev.

Another point of interest is that the 279-kev excited level in Ta^{203} can also be obtained in a different way. A. Lutz, M. Pool, and J. Kurbatov[4] when examining the β-radiation from 52-hour Pb (ascribed by them to Pb^{205}) found internal conversion lines corresponding to γ-rays of 270 and (possibly) 470 kev (explained as Compton electrons). Since the 270-kev radiation is very probably the same γ-line as our 279 kev, it is then almost certain that the 52-hour Pb has the mass 203 and decays by K-capture to Ta^{203} with emission of a γ-ray of 279 kev. A fuller description will appear in Arkiv. f. Mat., Astr. o. Fys.

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Single Crystal Growth of Scheelite

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SCHEELITE, $CaWO_4$, has been shown to be one of the most efficient crystals for gamma-ray counter applications.[1] For this purpose clear, transparent, single crystal material of reasonable size ($\sim$0.5 cc) is required. Since natural scheelite of sufficient purity and size is quite rare, it is necessary to resort to some laboratory growth technique.

Our experiments show that scheelite of sufficient purity and size can be grown by either of two techniques: (a) by flame fusion, the Vernueil process, and (b) from the melt by the gradient technique.

The flame fusion process, such as is used for production of synthetic sapphires, has been described elsewhere.[2] In this process the feed material is carried, as a fine powder, into one of the lines of an oxygen-hydrogen burner and caused to melt in the flame. The molten material is collected on a refractory support and is caused to grow into a single crystal by suitable manipulation of the flame, feed, etc. The conditions necessary to cause satisfactory growth unfortunately cannot be precisely stated and contain a large personal factor. Our burner was of standard design and consisted of two concentric cylindrical tubes, 25 mm and 2.5 mm I.D., respectively. The central tube extended to within 25 mm of the outer tube face. It was through this central tube, connected to an overhead hopper, that the powder (-200 mesh) was introduced into the flame. $CaWO_4$ of fluorescent grade, made either by sintering or precipitation, was first used as a feed material and yielded cloudy polycrystalline boules. We attribute this result to the WO_3 deficiency of the powder or to volatilization of WO_3 or to both of these factors. Clear boules were first obtained after 4–10 percent by weight of WO_3 (-200 mesh) was mechanically incorporated into the feed, thus reducing the loss of WO_3 during growth. Any excess was apparently volatilized although best results were obtained with 4 percent WO_3 addition. Considerable trouble was experienced with cracking of the boules during cooling. This cracking was reduced by the use of a smaller radiation space around the boule. Material of the size $4 \times 4 \times 4$ mm was obtained by this method.

Much larger and more satisfactory material was grown from the melt by the gradient technique. In this process a melt of the material in a cone-shaped crucible was slowly lowered through a temperature gradient.[3] Platinum crucibles, 18 or 31 mm in diameter with 60-degree cone tips, have been used in our work. The crucible, filled with the melt, was held in a platinum resistance furnace at 1625°C* and slowly lowered through the furnace gradient (an average of 59 degrees/cm for an elevator lowering of 125 cm) at a speed of 3.2 hours/cm. The raw material was fluorescent grade $CaWO_4$ without any addition.

We have obtained satisfactory single crystal boules yielding fragments $5 \times 5 \times 5$ mm by this process but as described above serious cracking of the boules was experienced unless it was allowed to cool quite slowly after solidification.

The fluorescent and counter behavior of scheelite by either technique was entirely satisfactory.

* The melting point of scheelite has not been reported in the literature. As determined by us it is 1576°±5°C.
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Nuclear Shell Structure and Isomerism*

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THE shell structures[1–4]

$(1s)^2$
$(1s)^2\,(2p)^6$
$(1s)^2\,(2p)^6\,(2s)^2$
$(1s)^2\,(2p)^6\,(2s)^2\,(3d)^{10}$
$(1s)^2\,(2p)^6\,(3d)^{10}\,(4f)^{14}\,(5g)^{18}$