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LARGE-GRAINED ALPHA PLUTONIUM PRODUCED UNDER EXTREME PRESSURE
(Roland B. Fischer, Rocky Flats)

Theoretical considerations lead to a conclusion that at sufficiently high pressures, plutonium might exist only as alpha phase below the melting point. This provides the interesting possibility of allowing plutonium to solidify slowly under pressure directly into alpha phase. Thus, large grains of alpha plutonium might be produced for study.

Recent work at Rocky Flats supports the above hypothesis. Compared to the ordinary alpha microstructures, the new type of microstructure is far better defined and consists of large grains. Columnar grains about 10 mils in diameter and 60 mils in length have been produced. An example of one specimen is shown in Figure 1. Undoubtedly, larger grains or crystals can be produced in larger high pressure cells.

The specimens of large-grained alpha were produced by heating plutonium to about 560°C under a pressure of about 60 to 70 kilobars. The metal was cooled slowly while under pressure. An effort was made to maintain a sharp thermal gradient along the specimen.

By means of hot-stage microscopy, movies have been taken of the alpha-to-beta-to-alpha transformations as revealed by the topography of polished large-grained specimens. The alpha-to-beta transformation moved intermittently as an irregular-fronted wave across the grains, stopping or changing direction at grain boundaries. On return to the alpha phase, the specimen retained ghost images of the original alpha grains. This is an example of such studies as can be made on the new type of microstructure.

Back-reflection Laue patterns of the grains show that the specimens are in a strained condition after removal from the high-pressure cell. A five-hour heat treatment at 115°C appeared to relieve the strain because sharper Laue patterns were obtained after such treatment.

Future work includes an effort to make even larger alpha grains and to conduct basic studies on them.

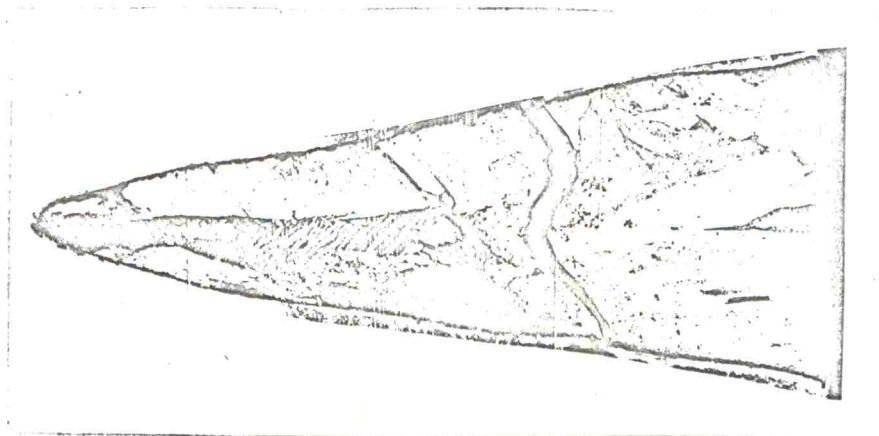


FIGURE 1

Polarized-light photomicrograph of a large-grained alpha plutonium specimen prepared under high pressure.