Transformation Pressures and Volumes of Transformation

The compression curves of some of the Pu-Al alloys containing between 1.7 and 12.5 a/o Al are shown in Figure 3. Irreversible transformations occur in the 1.7, 2.5, and 3.4 a/o Al alloys but no transformations were observed in the alloys containing from 4.0 to 12.5 a/o Al when compressed at pressures up to 10,060 atm. The transformations in the three alloys mentioned above result from changes of the

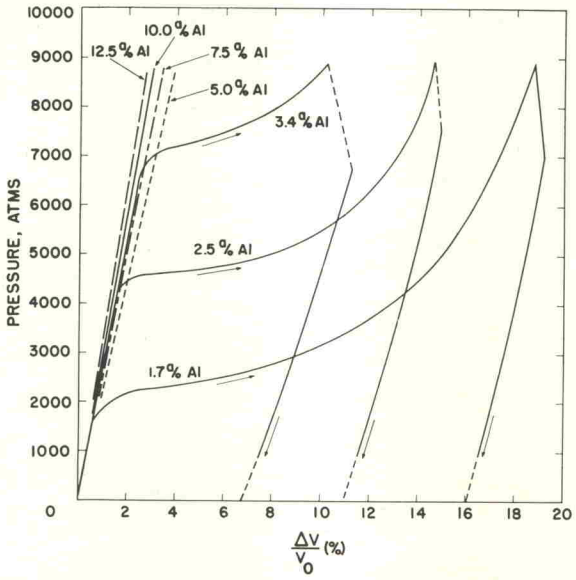

Fig. 3. Curves showing the effects of a cycle of compression and decompression on the per cent change in volume of delta-plutonium alloys containing aluminum in the concentrations of 1.7–12.5 a/o.

metastable delta phase into either alpha phase or a mixture of alpha and beta phases plus some untransformed delta. Figure 4 shows that the transformation pressures and volumes of transformation of these Pu-Al alloys vary linearly with atom per cent aluminum over the range of experimental measurements. The linear extrapolation to zero transformation pressure is interpreted as determining the minimum amount of aluminum, 1 a/o, required to retain delta phase at room temperature with the heat treatment being used. In order to verify this assumption, two alloys containing 0.8 and 1.2 a/o Al were heat-

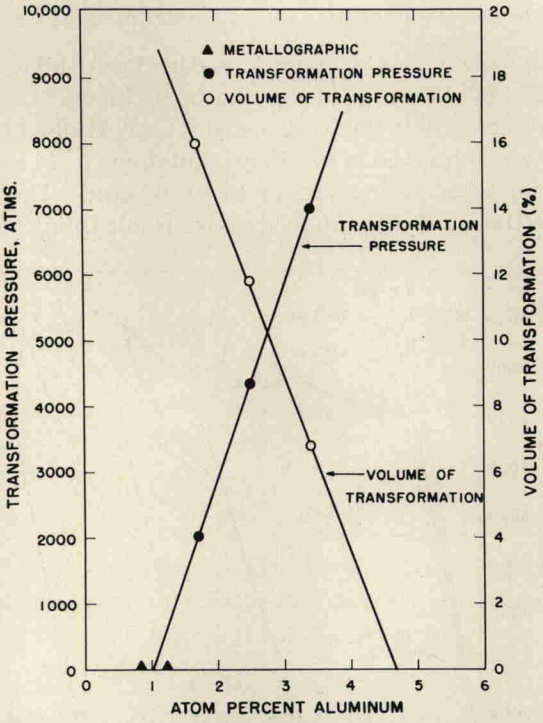

Fig. 4. Curves showing the effect of aluminum content on the pressure necessary to cause plutonium-aluminum alloys to transform from delta to lower allotropes and on the per cent change in volume associated with the transformation.

treated and examined. Upon examination, the 0.8 a/o Al alloy was found to consist mostly of alpha phase plus some beta and gamma phases and had a density of 17.7 g/cu cm. On the other hand, the 1.2 a/o Al alloy consisted of delta phase and had a density of 15.7 g/cu cm. Thus, this simple experiment provided additional justification for the meaning ascribed to the extrapolated composition at zero transformation pressure.

The compression curves of some of the Pu-Zn delta-stabilized alloys containing between 1.8 and 3.9 a/o Zn are shown in Figure 5. All of the metastable delta-phase Pu-Zn alloys transformed under compression. Their microstructures after compression showed them to be composed predominantly of alpha phase with traces of beta and usually some untransformed delta. Traces of the intermetallic