6 Compositional and pressure effects in the plutonium-gallium system:

H. R. Gardner

Lattice parameters, density, and hardness were determined on plutonium-gallium alloys containing 0.37 to 1.26 wt.-% gallium. Lattice parameter and density decrease with increasing gallium content while hardness increases because of solid solution strengthening. The author's data are compared with those of other investigators.

The effect of a 150,000 lb/in^2 pressure on alpha phase formation in both cored and homogenized alloy is presented. In addition the stability of alpha-delta phase mixtures with respect to annealing and room temperature storage is discussed. An explanation of the observed behaviour of alpha-delta phase mixtures is presented.

1 Introduction

1.1 In unalloyed plutonium, the delta phase region extends from 319 to 451°C. As indicated in the plutonium-gallium phase diagram, Fig 6-A,[1] the addition of appropriate quantities of gallium stabilizes the delta phase over a much wider range of temperatures including room temperature.

1.2 The metallurgy of delta stabilized plutonium-gallium alloys is complicated by three phenomena. During nonequilibrium cooling through the liquid plus epsilon and epsilon plus delta regions, coring, which is a type of segregation, occurs. This results in a variation in gallium content within each grain, the central portion having a much higher gallium concentration than that near the grain boundary. Using microprobe analysis, Johnson[2] has determined that the cored grains in a cast Pu 1.0 wt.-% Ga alloy range from 0.1 wt.-% Ga near grain boundaries to 1.5 wt.-% Ga at the centre. Coring can be eliminated by an appropriate anneal in the 400 - 500°C temperature range. Diffusion occurs and a uniform