

INTRODUCTION

A recent study of the influence of alloying elements on the γ - α electronic transformation of cerium revealed that the valence of the solute is quite important in determining the relative stabilities of the γ -Ce and α -Ce phases,¹ and it was shown that the higher the valence of the solute the greater is the tendency for the higher valent form (α -Ce) to be stabilized. That study, however, was limited to investigating the effects of solutes having valences equal to or greater than three, which essentially is the valence of the lower valent form (γ -Ce). The main reason for making the present investigation was to see if the ideas and conclusions established for the higher valent solutes would also apply to those having valences less than three.

Only a few elements having a valence of one or two are expected to be soluble in cerium.^{2,3} These are magnesium, calcium, ytterbium, europium, sodium and lithium. Experimental data indicate that magnesium is soluble in cerium,^{2,4} calcium is insoluble,^{2,5} and ytterbium and europium are soluble but appear to behave as if they were trivalent at concentrations below 1 or 2 a/o.⁶ There are no reliable experimental data concerning the solubilities of sodium and lithium in cerium.

Vogel and Heumann⁴ have given the most accurate description of the phase relationships in the cerium-rich portion of the cerium-magnesium phase diagram (figure 1). Their results indicate that about 24 a/o magnesium is soluble in the high-temperature body-centered cubic (δ) form of cerium, but they presented no accurate data for the solubility of magnesium in the phase of interest in the present investigation; i.e., face-centered cubic γ -Ce.*

Mahn's low-temperature magnetic susceptibility data⁷ indicate that at least 4 a/o magnesium is soluble in γ -Ce. Furthermore, her results also indicate that the $\gamma \rightarrow \alpha$ and $\alpha \rightarrow \gamma$ transformation temperatures decrease with increasing magnesium content and that the γ phase does not transform to α in alloys containing more than about 5 a/o magnesium.

* The solvus line shown in figure 1 between γ -Ce and the two phases γ -Ce + CeMg at about 450°C is based on results obtained in this study.

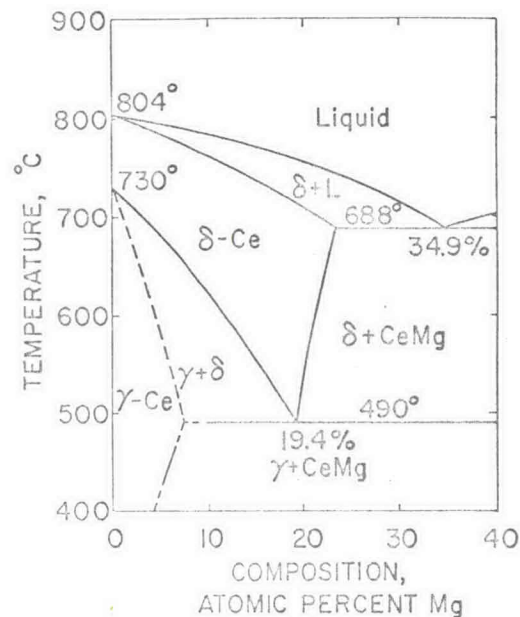


Fig. 1. Cerium-rich end of the cerium-magnesium phase diagram.

On the basis of the above information it was decided that the first step in this investigation would be to study the effect of magnesium additions on some of the physical properties of cerium. Since the paucity of reliable solid solubility data made it obviously necessary to obtain such data before attempting to interpret the low-temperature dilatometric data, the lattice constants of all alloys used in this investigation were measured to provide the needed solubility information.

EXPERIMENTAL

The alloy specimens were prepared by melting together weighed amounts of cerium and magnesium in an induction furnace. The chemical analysis of the cerium stock used in this study is shown in Table I. The molten alloys were cast to form right cylinders 0.6 cm diameter by 2.5 cm long, and the castings were heat