(1) Electronic transition
(2) Rare earths
(3) Thermal expansion

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THERMAL EXPANSION OF $LaRu_2$, $CeRu_2$ AND $PrRu_2$ FROM 20° TO 900°C*

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SUMMARY

The lattice parameters of $LaRu_2$, $CeRu_2$ and $PrRu_2$ have been measured from approximately 20° to 800°, 900° and 650°C, respectively. The lattice parameters expand smoothly and continuously as the temperature is increased. $CeRu_2$, however, expands at a much greater rate than either $LaRu_2$ or $PrRu_2$. This greater rate is thought to be due to the transfer of 0.07 electron from the valence band to a one-electron $4f$ band by thermal excitation.

INTRODUCTION

Cerium metal is known to undergo an electronic transformation*** at either 1 atm and 116°K or 7,670 atm and 298°K[1,2]. This transition involves the transfer of about 0.6 electron per atom from the $4f$ band to the $6s5d$ valence band as the cerium is cooled or compressed[2]. For a number of intermetallic compounds cerium is known to be in the higher valent form at standard temperature and pressure. Thus, it was thought that heating one of these compounds might cause the cerium to undergo an electronic transformation from the tetravalent to the trivalent state. If a compound should undergo such a transformation then one would expect a large volume change to occur, which could be easily detected by thermal expansion measurements.

$CeRu_2$ was chosen as the compound to be studied because it has a cubic structure ($C15$, $MgCu_2$ type Laves phase) and because its lattice constant deviates farther from the smooth curve established for the corresponding trivalent RRu_2 Laves phase compounds (where R = La, Pr, Nd etc.,) than do those of any of the other CeM_2 compounds (where M = Mg, Al, Ni, Rh, Os, Ir and Pt) from the respective curves established for the RM_2 compounds. GSCHNEIDNER[3] shows that for CeM_2 compounds the difference between the theoretical lattice constants (for trivalent cerium only) and

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*** Although this electronic transformation has been known for nearly 15 years the reader is referred to two recent papers (refs. 1 and 2), which summarize the older pertinent literature and also more recent data.