The Ce-Tm (Cerium-Thulium) System

140.12 168.9342

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Lattice Spacing

In their study of lattice spacings of Ce-rich alloys, Gschneidner *et. al.* [62Gsc] listed the lattice spacing (a = 0.51575 nm) for a Ce–2 at.% Tm alloy. The a value for this alloy exhibits a positive deviation from the Vegard's law line.

Cited Reference

62Gsc: Gschneidner, K. A. Jr., Elliott, R. O., and Prince, M. Y., in *Rare Earth Research,* Nachman, J. F. and Lundin, C. E., Ed., Gordon and Breach Science Publishers, New York, 71 (1962).

Ce-Tm evaluation contributed by **K. A. Gschneidner, Jr.**, Director, and **F. W. Calderwood**, Rare-earth Information Center, Ames Laboratory, Iowa State University, Ames, Iowa 50011. This work was supported by the Department of Energy through the Joint Program on Critical Compilation of Physical and Chemical Data coordinated through the Office of Standard Reference Data, National Bureau of Standards. Additional support was contributed by: Th. Goldschmidt AG, Essen, West Germany; Molycorp, Inc., Union Oil Co. of California, Los Angeles, CA; Reactive Metals & Alloys Corp., West Pittsburg, PA; Ronson Metals Corp., Newark, NJ; and Santoku Metal Industry Co. Ltd., Kobe, Japan. Literature searched through 1981. Professor Gschneidner is the ASM/NBS Data Program Category Editor for binary rare-earth alloys.

The La-Lu (Lanthanum-Lutetium) System

138.9055 174.967

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Phase Relationships

Lundin [66Lun] tried to include alloys of the La-Lu system in his study of the formation of the Sm-type structure in intra-rare-earth alloys. The wide differences in the melting points (La, 918 °C; Lu, 1663 °C) and densities (La, 6.146 g/cm^3; Lu, 9.841 g/cm^3) allowed the Lu to settle to the bottom of molten La during the alloying process. Alloys were inverted and remelted several times to improve the homogeneity. Lundin reported that (a) La-Lu alloys form a complex microstructure which has a different appearance than that of the Sm-type structure formed in the other alloy systems of a light and a heavy rare-earth metal, and (b) X-ray analysis failed to confirm the presence of the Sm-type structure in this system. The X-ray pattern from a 34 at.% La–66 at.% Lu alloy could be indexed on the basis of the coexistence of αLa (dcph) and αLu (cph) solid solutions. These data suggest that a two-phase miscibility gap exists in the low-temperature region of this system. Lundin proposed that the most probable phase equilibria to accommodate this miscibility gap would be a eutectoid reaction of the high-temperature bcc allotrope to the two terminal (La plus Lu) solid solutions. On the basis of the two-phase character of the microstructure, Lundin deduced that the assumed eutectoid would be near 34 at.% La–66 at.% Lu.

The reviewers, however, suggest an alternate model for the phase equilibria in this region of the La-Lu system. At high temperature, we propose that the dcph La and cph Lu phases form a continuous series of solid solutions, which upon cooling form a miscibility gap between the two terminal solid solutions. This construction would be essentially identical to the phase relationships observed in the Nd-Sc system by Beaudry *et al.* [65Bea] and similar to that observed in the Gd-La system in that the cph Gd phase forms a continuous series of solid solutions with the dcph La phase at high temperatures (see Fig. 1, Vol. 2, No. 4, p 448). Clearly, a careful experimental study needs to be made of the 20 to 50 at.% La region of the La-Lu system, especially at high temperatures.

Anderson *et al.* [58And] measured the effect of Lu additions on the superconducting transition temperature of La and reported that alloys containing 55 and 80 at.% La each had the La dcph structure. These results are consistent with those reported above by Lundin.

Lattice Spacings

Lundin [66Lun] reported lattice spacings for the two phases found in a 34 at.% La–66 at.% Lu alloy. For the La solid solution, he found a = 0.3727 nm and c = 1.2028 nm. For the Lu solid solution, he reported a and c lattice spacings of 0.3547 nm and 0.5642 nm, respectively.

Cited References

58And: Anderson, G. S., Legvold, S., and Spedding, F. H., *Phys. Rev., 109,* 243 (1958).
65Bea: Beaudry, B. J., Michel, M., Daane, A. H., and Spedding, F. H., in *Rare Earth Research,* III, Eyring, L., Ed., Gordon and Breach, New York, 247 (1965).
66Lun: Lundin, C. E., AD-633558 (also given as DRI-2326), Final Report, Denver Research Institute, University of Denver, Denver, CO (1966).