

Wang, Gabe, Calvert & Taylor, 1976; Larson & Gabe, 1978). The space group was determined from precession photographs (hkl : $h + k + l = 2n$; hhl : $2h + l = 4n$) and intensity statistics to be $I\bar{4}3d$. The systematic absences were also measured to check the possibility that the crystal had lower symmetry due to ordering (Carter, 1972). In addition, the La_4Sb_3 data were refined in $I2_13$ to a result not significantly different from $I\bar{4}3d$. Details for each crystal are given in Table 1. Two complete unique sets, each containing hkl and $\bar{h}\bar{k}\bar{l}$, were measured and averaged. All calculations were carried out on the laboratory computer using the NRC-PDP-8 system of programs (Larson & Gabe, 1978). The structure was refined using the observed reflections with allowance for anomalous dispersion and isotropic extinction (Larson, 1969). For Eu_4As_3 extinction was negligible and not refined. Refinement was by anisotropic full-matrix least squares with starting coordinates from Hulliger & Vogt (1970).*

For both structures the final difference maps contained no significant details. (A refinement with variable As occupancy did not give significantly different results.) A microprobe analysis (Owens, 1978) of the Eu-As crystal gave $\text{Eu}_{4.01(3)}\text{As}_{2.99(3)}$. The stoichiometric formula was therefore accepted for our crystal.

For comparison, La_4Sb_3 , known to be stoichiometric (Gambino, 1967), was also studied.

Discussion

The Th_3P_4 structure (Meisel, 1939) has been described in detail elsewhere (Heim & Bärnighausen, 1978, and references therein). The anti version of this structure is observed for pnictides of the rare earths, Ln_4X_3 (Hohnke & Parthé, 1966; Bodnar & Steinfink, 1966; Gambino, 1967; Hulliger & Ott, 1977), but to date no diffractometer single-crystal study is known to us. Structural details are of interest in discussing the superconductivity of Ln_4X_3 compounds which are an order of magnitude different from the analogous Ln_3Y_4 ($Y = \text{S}, \text{Se}, \text{Te}$) compounds with the normal Th_3P_4 structure. The interatomic distances are given in the *Abstract* and the average Ln-X values, *viz* $\text{Eu-As} = 3.20 \text{ \AA}$ and $\text{La-Sb} = 3.34 \text{ \AA}$, are equivalent to those expected for Ln^{3+} metallic phases. Each Ln atom is connected to three other Ln atoms (Maas, 1970), forming two distinct enantiomorphic sets of three-connected ten-membered rings (Heim & Bärnighausen, 1978) in which the bonding is comparable to that for the Ln^{3+} metal. For La these are the face-centred

cubic and double hexagonal close-packed forms of the element (3.75 and 3.77 Å respectively) and for Eu^{3+} the 12-coordination value is 3.60 Å. Similar geometrically distinguishable Ln sublattices are observed in other lanthanon pnictides, even anion-rich ones, *e.g.* the high- and low-temperature forms of LaAs_2 , and in NdAs_2 (Wang, Heyding, Gabe, Calvert & Taylor, 1978). The lattice parameter and stoichiometry found for La_4Sb_3 are in excellent agreement with those of Hulliger & Ott (1977), 9.6485 (8) Å and $\text{La}_4\text{Sb}_{2.94-3.02}$, and consistent with those of Hohnke & Parthé (1966), 9.648 Å, and Gambino (1967), 9.63 Å. For Eu_4As_3 both lattice parameter and stoichiometry differ from those given by Hulliger & Vogt (1970) and we conclude that our single crystal is stoichiometric Eu_4As_3 .

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References

- BODNAR, R. E. & STEINFINK, H. (1966). *Inorg. Chem.* **6**, 327-330.
- CARTER, F. L. (1972). *J. Solid State Chem.* **5**, 300-313.
- GABE, E. J. & O'BYRNE, T. (1970). Research Report R231. Department of Energy, Mines & Resources, Ottawa.
- GAMBINO, R. J. (1967). *J. Less-Common Met.* **12**, 344-352.
- GRANT, D. F. & GABE, E. J. (1974). Report No. 14325. National Research Council of Canada.
- GRANT, D. F. & GABE, E. J. (1978). *J. Appl. Cryst.* **11**, 114-120.
- HEIM, H. & BÄRNIGHAUSEN, H. (1978). *Acta Cryst.* **B34**, 2084-2092.
- HOHNKE, D. & PARTHÉ, E. (1966). *Acta Cryst.* **21**, 435-437.
- HULLIGER, F. & OTT, H. R. (1977). *J. Less-Common Met.* **55**, 103-113.
- HULLIGER, F. & VOGT, O. (1970). *Solid State Commun.* **8**, 771-772.
- LARSON, A. C. (1969). *Crystallographic Computing*, pp. 291-294. Copenhagen: Munksgaard.
- LARSON, A. C. & GABE, E. J. (1978). *Computing in Crystallography*, pp. 81-89. Delft Univ. Press.
- OWENS, D. R. (1978). Physical Sciences Laboratory Report M-2948, CANMET.
- MAAS, K. E. (1970). *Z. Anorg. Allg. Chem.* **374**, 11-18.
- MEISEL, K. (1939). *Z. Anorg. Allg. Chem.* **240**, 300-312.
- TAYLOR, J. B., CALVERT, L. D., UTSUNOMIYA, T., WANG, Y. & DESPAULT, J. G. (1978). *J. Less-Common Met.* **57**, 39-51.
- WANG, Y., GABE, E. J., CALVERT, L. D. & TAYLOR, J. B. (1976). *Acta Cryst.* **B32**, 1440-1445.
- WANG, Y., HEYDING, R. D., GABE, E. J., CALVERT, L. D. & TAYLOR, J. B. (1978). *Acta Cryst.* **B34**, 1959-1961.

*Lists of structure factors for both compounds have been deposited with the British Library Lending Division as Supplementary Publication No. SUP 34788 (10 pp.). Copies may be obtained through The Executive Secretary, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

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