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[1] Garrett, R. R., and Flory, P. J., *Nature*, **177**, 176 (1956).
[2] Witnauer, L., and Fee, J. G., *J. Polymer Sci.*, **26**, 141 (1957).
[3] Wiederhorn, N. W., Reardon, G. V., and Browne, A. R., *J. Amer. Leather Chem. Assoc.*, **48**, 7 (1953).
[4] Gustavson, K. H., *J. Amer. Leather Chem. Assoc.*, **55**, 564 (1960).
[5] Stark, G. R., Stein, W. H., and Moore, S., *J. Biol. Chem.*, **235**, 3177 (1960).
[6] Waugh, D. F., in *Advances in Protein Chemistry*, **15**, 325, edit. by Anson, M. L., Bailey, K., and Edsall, J. T. (Academic Press, Inc., New York, 1954).

METALLURGY

New Ternary *R*-Phases with Silicon

The *R*-phase was first found[1] in the chromium–molybdenum–cobalt ternary system. Its crystal structure has been determined by Shoemaker *et al.*[2]. Additional *R*-phases were later found in the molybdenum–manganese–cobalt and molybdenum–manganese–iron ternary systems[3], as well as in the titanium–manganese binary system[4]. Recently, in the investigation of several ternary systems with silicon a number of new *R*-phases have been identified. Table 1 gives the approximate composition and the lattice parameters of these new *R*-phases:

Table 1. Composition (approximately) and Lattice Parameters of New *R*-Phases

Alloy	Annealing temperature (° C.)	*c* (Å.)	*a* (Å.)	*c*/*a*
$Ti_5Mn_{79}Si_{16}$	1,000	19·23	10·87	1·77
$Nb_5Mn_{79}Si_{16}$	1,000	19·28	10·89	1·77
$Ta_5Mn_{79}Si_{16}$	1,000	19·19	10·86	1·77
$Mo_5Mn_{76}Si_{19}$	1,000	19·18	10·85	1·77
$W_5Mn_{76}Si_{19}$	1,000	19·22	10·86	1·77
$V_{37}Fe_{41}Si_{22}$	1,100	19·23	10·79	1·78
$V_{45}Co_{40}Si_{15}$	1,100	19·14	10·78	1·78
$V_{45}Ni_{40}Si_{25}$	1,100	19·10	10·82	1·77

It is interesting to note that in all alloys as yet known to consist of the *R*-phase one of the component elements has a relatively large co-ordination number 12 atomic radius in relation to that of the others. For example, in all the *R*-phases listed in Table 1, the ratio of the co-ordination number 12 radii of the two transition elements lies between 1·07 and 1·12. In the case of the ternary *R*-phases with manganese and silicon the concentration of the element with the large atomic radius needed in order to stabilize the *R*-phase may be quite small, for example, 2 *a*/*o* titanium, 5 *a*/*o* niobium or tantalum, 3 *a*/*o* molybdenum or tungsten. However, the amount of vanadium required in the ternary systems with iron, cobalt or nickel and silicon is very much larger.

It has now been established that the unidentified phases previously designated as I, III and V co-existing with the σ-phase in the vanadium–iron–silicon, vanadium–cobalt–silicon and vanadium–nickel–silicon systems[5] are identical with the corresponding *R*-phases listed above. Previously unidentified phases II and IV also co-existing with the σ-phase in the vanadium–iron–silicon and vanadium–cobalt–silicon systems have now been identified as having the α-Mn structure. An α-Mn phase also occurs in the vanadium–nickel–silicon system. Details of these phase relations will be published.

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[1] Rideout, S. P., Manly, W. D., Kamen, E. L., Lement, B. S., and Beck, P. A., *Trans. Amer. Inst. Mech. Eng.*, **191**, 872 (1951).
[2] Komura, Y., Sly, W. G., and Shoemaker, D. P., *Acta Cryst.*, **13**, 575 (1960).
[3] Das, B. N., and Beck, P. A., *Trans. Amer. Inst. Mech. Eng.*, **218**, 733 (1960).
[4] Waterstrat, R. M., *Trans. Amer. Inst. Mech. Eng.*, 221, 687 (1961).
[5] Gupta, K. P., Rajan, N. S., and Beck, P. A., *Trans. Amer. Inst. Mech. Eng.*, **218**, 617 (1960).

α-Manganese Phases containing Technetium-99

The existence of α-manganese phases in the zirconium–technetium, niobium–technetium and molybdenum–technetium systems was recently reported by V. B. Compton *et al.*[1]. During the course of our investigation of alloy phases involving technetium-99 with transition metals, α-manganese phases were found in the binary systems scandium–technetium, titanium–technetium, hafnium–technetium and tantalum–technetium. Pertinent information is given in Table 1. The alloys were made by arc-melting transition metals of high purity with technetium-99. X-ray data were obtained from specimens in the as-cast condition with a powder camera of 114·6 mm. diameter using filtered copper radiation.

Table 1. Lattice Parameters of Several α-Manganese Phases containing Technetium-99

System	X-ray data: Alloy composition, atomic per cent	a_0 (Å.)
Sc–Tc	87·5 Tc; 12·5 Sc	9·509 ± 0·001
Ti–Tc	87·5 Tc; 12·5 Ti	9·579 ± 0·001
Hf–Tc	87·5 Tc; 12·5 Hf	9·603 ± 0·001
Ta–Tc	83·3 Tc; 16·7 Ta	9·565 ± 0·001

Crystal structure and lattice dimensions of technetium-99 have already been reported by R. C. L. Mooney[2], using a microgram specimen. He found a hexagonal close-packed structure with $a_0 = 2{\cdot}735 \pm 0{\cdot}001$ Å., $c_0 = 4{\cdot}388 \pm 0{\cdot}001$ Å., $c/a = 1{\cdot}604$. In the present investigation lattice dimensions of technetium-99 were obtained from an annealed needle of high-purity technetium-metal. The dimensions are as follows: $a_0 = 2{\cdot}743 \pm 0{\cdot}001$ Å., $c_0 = 4{\cdot}400 \pm 0{\cdot}001$ Å., and $c/a = 1{\cdot}604$. Since Mooney reported a slight impurity in his mixed sample, the lattice parameters reported here are probably more accurate.

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[1] Compton, V. B., Corenzwit, E., Maita, J. P., Matthias, B. T., and Morin, F. J., *Phys. Rev.*, **123**, 1567 (1961).
[2] Mooney, R. C. L., *Acta Cryst.*, **1**, 161 (1948).