NATIONAL BUREAU OF STANDARDS REPORT

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CRYSTAL STRUCTURE TRANSFORMATIONS IN VPt PRODUCED BY PLASTIC DEFORMATION AT ROOM TEMPERATURE

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CRYSTAL STRUCTURE TRANSFORMATIONS IN VPt PRODUCED BY PLASTIC DEFORMATION AT ROOM TEMPERATURE

by

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Crystal Structure Transformations in VPt Produced by Plastic Deformation at Room Temperature

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The phase VPt has been reported to have a crystal structure of the B19 (AuCd) type at low temperatures.[1,2] A recent investigation[3] has indicated that this phase forms by an ordering reaction from the disordered face-centered cubic Pt(V) solid solution which is stable at high temperatures. Ölander[4] has shown that there exists a close structural relationship between the orthorhombic B19 structure and a face-centered cubic structure possessing the $L1_0$ (CuAu) type of atomic ordering. One may derive the B19 structure by a shear-like displacement of the atoms in the (002) plane of the ordered face-centered cubic lattice along the <010> direction through a distance equal to one eighth of the unit cell dimension (see Fig. 1) followed by an orthorhombic distortion of the cube axes such that a = 2.693 Å, b = 4.413 Å and c = 4.767Å (estimated uncertainty ± 0.005Å).

Filings of this phase were produced by grinding a VPt alloy having the B19 structure with a diamond dental grinding disc. When these filings were subjected to x-ray diffraction examination, a pattern of a severely cold-worked face-centered cubic structure was obtained. When the filings were annealed in a high vacuum furnace for 15 minutes at 1100°C, however, they returned to the B19 structure perhaps as a result of re-ordering. Subsequent less-severe cold-working of these filings by grinding in a hardened steel mortar and pestle at room temperature produced a transformation into a cold-worked $L1_0$ structure which was slightly tetragonal. Thus it appears that the degree of deformation may influence the final structure. Considerable line-broadening was observed in x-ray diffraction patterns obtained from the cold-worked filings and therefore no attempt was made to obtain accurate lattice parameters. Vacuum annealing treatments at 1100°C intended for strain relief resulted in transformations to the B19 structure.

Alloys were also prepared containing the B19 structure in equilibrium with the face-centered cubic disordered Pt(V)

solid solution at compositions between 40 and 50 atomic per cent vanadium by annealing in high vacuum for three days at 1300°C. A typical microstructure of the alloy $V_{43}Pt_{57}$ is shown in Fig. 2. Examination under crossed polarizers indicated that the striations were a second phase (presumably the B19 phase) which frequently forms initially at primary grain boundaries and then grows toward the interior as thin ribbons. X-ray studies on filings of this alloy re-annealed at 1300°C for 15 minutes indicated a strong pattern of the face-centered cubic phase together with a substantial pattern of the B19 phase. The unannealed filings, however, showed only the pattern of a cold-worked, face-centered cubic structure. In these two-phase alloys it appears, therefore, that the B19 phase is transformed into a disordered face-centered cubic structure by cold-working. The mechanical properties of these alloys would be of some interest since a face-centered cubic structure might be expected to possess greater ductility than the orthorhombic B19 structure from which it forms.

Acknowledgment

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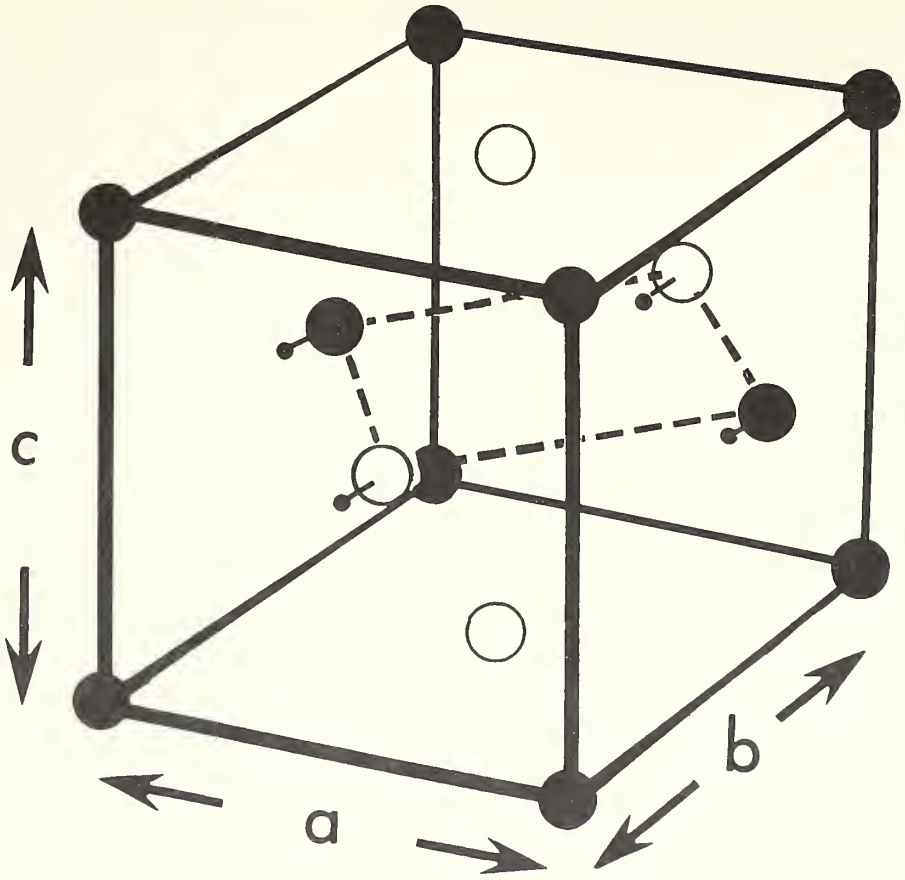

○ VANADIUM
● PLATINUM
• atom sites in a face-centered cubic structure

Figure 1. Schematic derivation of the B19 (AuCd) structure from an ordered face-centered cubic structure by sheer displacement along the <010> direction to be followed by an orthorhombic distortion of the cube axes.

Legend of Figures

Figure 1. Schematic derivation of the B19 (AuCd) structure from an ordered face-centered cubic structure by shear displacement along the <010> direction to be followed by an orthorhombic distortion of the cube axes.

Figure 2. The alloy $V_{43}Pt_{57}$ annealed for three days at 1300°C. Thin ribbons of the B19 phase in a disordered face-centered cubic matrix of the platinum (V) solid solution. Oblique incident illumination. 550x.

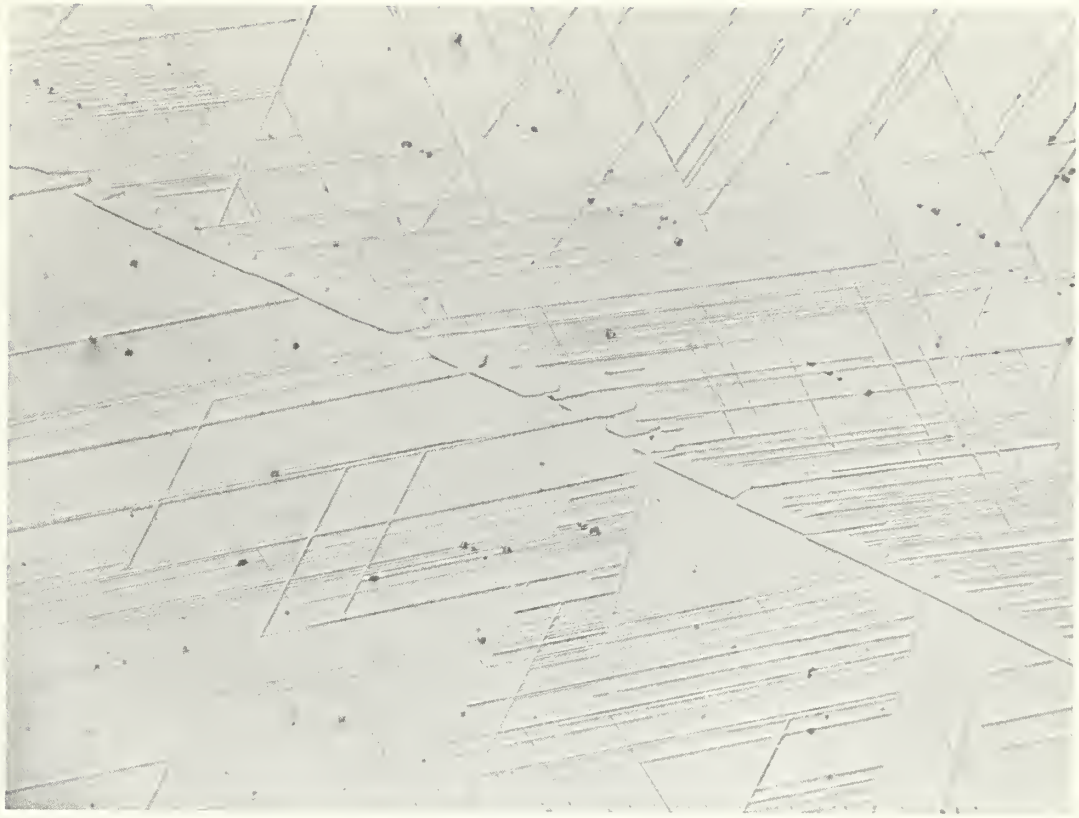

Figure 2. The alloy $V_{43}Pt_{57}$ annealed for three days at 1300 °C. Thin ribbons of the B19 phase in a disordered face-centered cubic matrix of the platinum (V) solid solution. Oblique incident illumination. 550x.


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