in the sediments derived from these pulses. Furthermore, the individual pulses would be datable on the types of non-reworked pollen and spores present in these sediments. The dating of these pulses should be helpful in corroborating other palynological information such as that obtained from relic surface studies used by Axelrod and Ting[15] and recently discussed by Cotton[16].

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CRYSTALLOGRAPHY

Novel Ordered Phase, Pt_8Ti

DURING an investigation of platinum-rich alloys in the titanium–platinum binary system an intermediate phase of the composition Pt_8Ti was discovered. The crystal structure of this phase has been determined by me[1]. This arrangement of atoms is of particular interest because of the fact that it is an ordered configuration which is not greatly different from AuCu (ref. 2), Au_8Mn_2 (ref. 3), and Au_4Ti (ref. 4). These phases are characterized by the fact that the location of atoms represents minor deviations from a face-centred cubic solid solution, and also that different species of atoms display a preference for particular crystallographic sites. The ordered phase Pt_8Ti exists over a region of homogeneity as does Au_4Ti. Furthermore, it is quite interesting to note that the addition of titanium to platinum decreases the lattice parameter of the parent terminal phase. A similar effect was observed in the titanium–gold system[5].

Diffraction photographs made with characteristic copper X-rays were readily indexed in the tetragonal system. This possibility was suggested by the positions of the very strong diffraction maxima and similarities between X-ray powder photographs of Pt_8Ti and Au_4Ti. The lattice parameters of Pt_8Ti were determined from results obtained with a 143·2-mm Debye Scherrer camera in which chromium K_α was used. Least squares analysis of the data from {600} $K\alpha_1K\alpha_2$, {332} $K\alpha_1K\alpha_2$, {631} $K\alpha_1K\alpha_2$, and {303} $K\alpha_1K\alpha_2$ yielded the following results:

$$a_3 = b_3 = 8{\cdot}31_2,\ c_3 = 3{\cdot}89_7, \text{ and } c_3/a_3 = 0{\cdot}469$$

The crystal structure was determined from an X-ray powder diffraction film which had been made in a Hägg modified Guinier camera with mono-chromated copper radiation. A total of twenty-six different reflexions were observed and indexed. Systematic extinctions were of the type: (hkl) absent if $h+k+l \neq 2n$. Therefore, the space lattice was considered to be body-centred tetragonal. The unit cell contains eighteen atoms: two titanium and sixteen platinum atoms. It was observed that if one only considered the strongest diffraction maxima in Pt_8Ti it was possible to formulate a four-atom pseudo unit cell which was face-centred tetragonal. Appropriate mathematical matrix methods immediately yielded proper indexing for large unit cell and an initial or trial position of the atoms. The intensities of the various reflexions were calculated with an electronic computer, and best agreement was obtained when the eighteen atoms were placed in the following positions of space group D_{4h}^{17}:

0, 0, 0; 1/2, 1/2, 1/2+

2 Ti in (a): 000

8 Pt in (h): $X, X, 0$; $\bar{X}, \bar{X}, 0$; $X, \bar{X}, 0$; $\bar{X}, X, 0$ with $X_1 = 0{\cdot}333$

8 Pt in (i): $X, 0, 0$; $\bar{X}, 0, 0$, $0, X, 0$; $0, \bar{X}, 0$ with $X_2 = 0{\cdot}327$

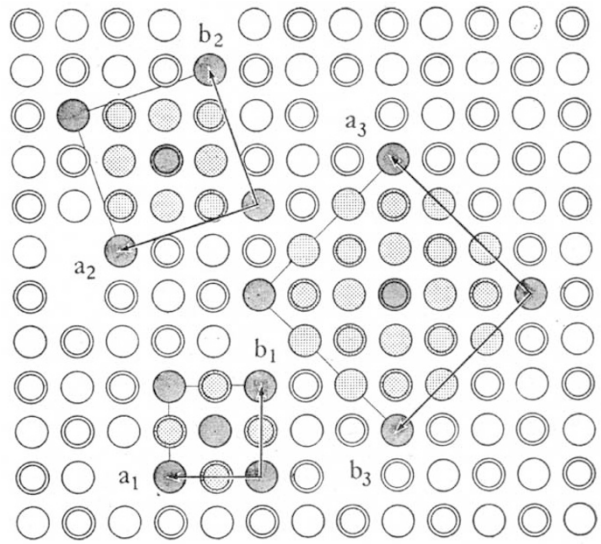

Fig. 1. A schematic representation of lattice relationships between the AuCu type and the Au_4Ti and Pt_8Ti type crystal structures. The single circles and concentric circles indicate nets of atoms which are displaced from one another by one-half the unit cell dimension in a direction normal to the plane of the paper. The vector subscripts one, two, and three refer to lattices of the AuCu, Au_4Ti, and Pt_8Ti type, respectively

The relationship between atomic positions in the ordered phases is shown in Fig. 1. A tetragonal space lattice has been illustrated. The unique direction of the latter is normal to the plane of the paper and its magnitude such that the axial ratio is slightly less than unity. A unit cell for the AuCu type crystal structure which contains four atoms is represented by the vector triple, $\vec{a}_1, \vec{b}_1, \vec{c}_1$. The ordered phase of the Au_4Ti type contains ten atoms/unit cell. Schematically this is represented by the translations $\vec{a}_2, \vec{b}_2, \vec{c}_2$. The unit cell of the Pt_8Ti type phase contains eighteen atoms; these are shown in the same space lattice as has been used for the other ordered phases. The ideal positions of the atoms, which constitute the basis of a trial structure, is easily seen. The indexing of strong maxima corresponding to the small pseudo cell can be determined by writing vector relationships between $\vec{a}_1, \vec{b}_1, \vec{c}_1$ and $\vec{a}_3, \vec{b}_3, \vec{c}_3$.

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