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The Study of the Formation of Pt_8Cr in the Platinum-rich Portion of the Pt-Cr Binary System

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The platinum-rich end of the platinum-chromium binary system is reported to be a single-phase solid solution with atomic ordering observed only in alloys containing from 20 to 65 at.% chromium [1]. This was revealed by existence of superlattice line in X-ray diffraction patterns. At stoichiometric composition Pt_3Cr, a Cu_3Au $L1_2$ type structure was observed[2,3]. For the equiatomic PtCr a CuAu $L1_0$ type was observed. For the other compositions within the ordered region, a continuous variation in site occupancies was observed such that the structure changes progressively from the $L1_2$ type to the $L1_0$ with increasing chromium content.

In the present work, anomalous behaviour was noted in hardness measurements of specimens from a cold worked alloy containing 10 at.% chromium after it was heat-treated at temperatures below 500°C. In order to investigate this anomaly, transmission electron microscopy and electron diffraction experiments were carried out. Results revealed evidence for the formation of a low temperature ordered phase of unreported structure type and composition: Pt_8Cr.

The alloys were prepared by induction melting in argon atmosphere. The alloys were homogenised at 1000° for 14 hrs and the composition and homogeneity of the alloy were checked using EDX. The alloy was cold rolled and the specimens were heat treated for 6 hours at temperatures between 300°C and 500°C. The selected area electron diffraction technique was used to determine the structure of the ordered phase that formed after heat treatment of the disordered solid solution. Fig. 1(a) through 1(c) show electron diffraction patterns orientated to the [100], [110] and [103] zone axis of the matrix. Fig. 1 (d) shows a dark field image from the imaged through the $\frac{1}{3}$<220> superlattice spot with ordered regions appearing in bright contrast. These diffraction patterns cannot be indexed on the basis of the $L1_2$ or $L1_0$ type reported in compositions above 20 at.% chromium content [1]. The structure that accounts for all the diffraction patterns is identified as ordered fct Pt_8Cr of which Pt_8Ti is the prototype[4].

References

[1] R.M. Waterstrat, Met. Trans. 4 (1973) 1585.
[2] A. Kusmann et al., Z. Metallk. 59 (1968)859.
[3] S.J. Pickart and R. Nathans, J. Appl. Phys. 34 (1963) 455.
[4] P. Pietrowsky, Nature 209 (1969) 291
[5] M.J Mostafa and A.J. Ardell Materials Letters 6 (1987). 67.
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The equivalent Bravais lattice is a bct cell with a=b~$3a_0$ and c~a_0 where a_0~3.92Å is the lattice parameter of the solid solution matrix. The electron diffraction data obtained from the platinum-chromium alloy are consistent with all the A_8B ordered phases known to date where A is Ni, Pd or Pt and B is from group IV to VI transition elements [5].

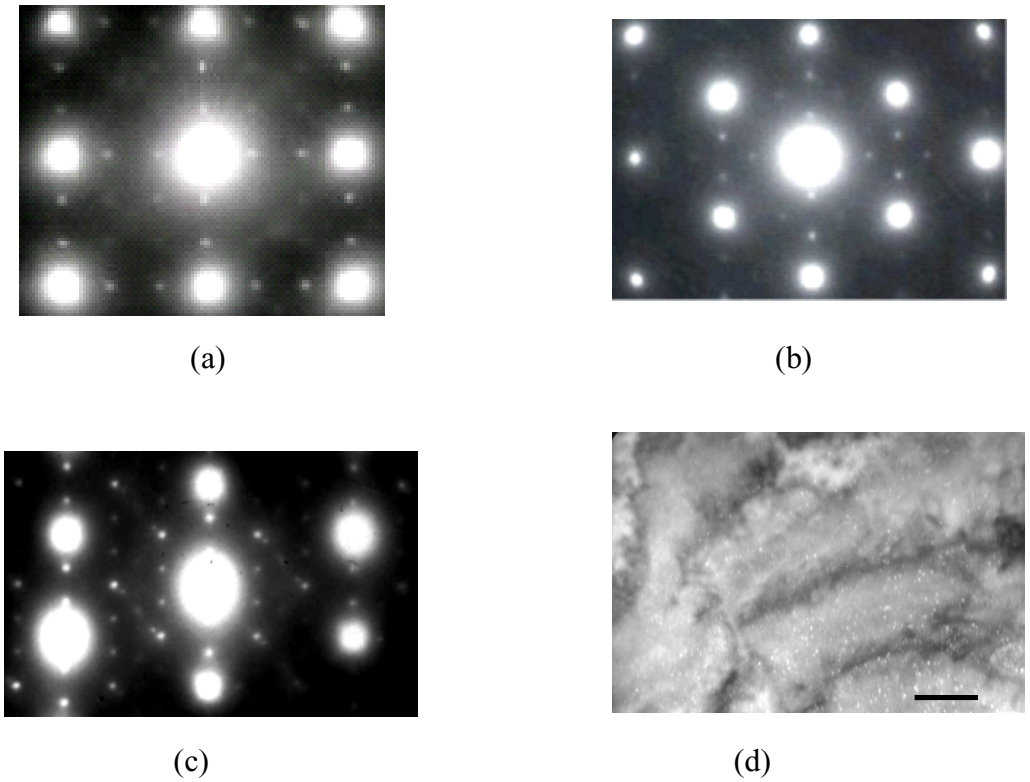

FIG. 1. Electron diffraction patterns from Pt 10 at.% Cr solid solution heat treated at 400°C for 6hrs: (a) [100], (b) [110], and (c) [103] zone axes of the matrix showing extra reflections every $\frac{1}{3}$ along the <200>, <220> and the <131> directions. Fig.1 (d) shows a dark field image obtained from a Pt 10 at.% Cr specimen after heat treatment at 400°C, imaged through the $\frac{1}{3}$<220> reflection, showing in bright contrast ordered regions (10nm on micromarker).

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