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ABSTRACTS OF PAPERS
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A New Type of Long Period Superlattice with Hexagonal Symmetry in Au–Cd Alloys*

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Abstract

The existence of a new type of long period superlattice having hexagonal symmetry, whose period is determined by the critical contact of the Brillouin zone boundaries with the Fermi surface, has been established. The ordering of the atoms on the close packed hexagonal plane of these structures is derived from that of the $A_3B$ type (Cu$_6$Au type) structure, but the long period is produced in the basal plane by the existence of antiphase boundaries in three directions perpendicular to the close packed plane and making 120° with each other, thus creating the hexagonal symmetry. The stacking of the close packed layers is of either the $2H$ or $4H$ type. The size of this hexagonal unit cell is found to be between seven and nine times as large as that of the hexagonal unit cell of the disordered close packed lattice, these limiting cases being called the $7a_0$ structure and the $9a_0$ structure respectively. Significantly, the period of this structure is found to respond to a change of $e/a$ in a fashion similar to that found in the one dimensional long period superlattice, which has been investigated in detail. In the case of the Au-Cd alloys, the stacking is of the $2H$ type and the $7a_0$ structure is identified as Au$_{72}$Cd$_{28}$ with space group P$ar{6}_3$mnc, and the $9a_0$ structure as Au$_{48}$Cd$_{12}$ with P$ar{6}_3$mcm. The geometry of the Brillouin zone structure indicates that the structure is stabilized by creating superlattice Brillouin zone boundaries at the flat part of the Fermi surface (in the (110) directions in the case of the fcc structure), as in the case of the one dimensional long period superlattice. Examples of these new structures are found, other than in the Au-Cd alloys reported here, in Au-Mg alloys, Cu-Sb alloys, etc. near the $A_3B$ composition range. These structures are usually found among the long period stacking variants of a one dimensional long period superlattice with non variable period ($M-1$, $M-2$, etc.), occurring in these alloys.