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Physics discovery made at UCSD

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A recent discovery in metal physics by scientists at the University of California, San Diego has resulted in new insights into the nature of alloys, and, at the same time, dramatically illustrates the international character of science and of the University.

The discovery, dealing with atomic rearrangement in alloys, was made by a team of four scientists, each from a different country, who came together temporarily at UCSD. Only one of the researchers is an American. He is Dr. Marshal F. Merriam, Assistant Professor of Physics at UCSD. His colleagues in the research work were Mr. Tord Claeson, a Swedish graduate student studying at UCSD for two years under a special exchange arrangement; Dr. Huey-Lin Luo, a Chinese postdoctoral research physicist working at UCSD; and Dr. T. R. Anantharaman, a visiting professor from Banaras Hindu University in India. Dr. Anantharaman has returned to India and Mr. Claeson will return to Sweden in March.

Their cooperative effort is a good example of the way science generally, and major universities specifically, build bridges between nations and cultures -- bridges which are desperately needed in today's world.

The research work of the international team will be published as a scientific paper in the journal Acta Metallurgica later this year. It consisted of proving, by means of low temperature electrical measurements and x-rays, that a type of atomic rearrangement in alloys, known as order-disorder transformation, can and does occur at a two-to-one (2:1) composition ratio in binary alloys. Such alloys consist of only two elements.

A large number of cases of order-disorder transformations are known at both three-to-one and one-to-one composition ratios, but not at any ratios other than these until the present work at UCSD. In their study, the UCSD group used an alloy of cadmium (Cd) and mercury (Hg) at compositions of two parts cadmium to one part mercury (Cd 2 Hg) and the reverse, two parts mercury to one part cadmium (CdHg2).

The nature of an order-disorder transformation in a metal may be better understood through an analogy: a checkerboard with a red or black checker on each square. The squares of the checkerboard correspond to the sites in the crystal structure, or lattice, of the metal. This structure consists of the rows and patterns of atoms, which have a definite arrangement in each crystal.

The checkers on the board correspond to the atoms. The total number of checkers is fixed (equal to the number of squares), but the relative proportion of red and black depends upon composition. If the red checkers represent mercury atoms and the black checkers represent cadmium atoms then the two-to-one alloy composition of mercury to cadmium (CdHg2), for example, would have twice as many red checkers as black.

If, in the above alloy, the red and black checkers were placed randomly on the squares, there would be one checker on each square but no long range color pattern. This would correspond to a disordered alloy. However, if the checkers were to arrange themselves in a color pattern on the checkerboard of the sort: red-red-black, red-red-black, and so on, this pattern would correspond to an ordered alloy.

Working with low temperature electrical measurements and x-rays, the research team at UCSD found that the atoms of the alloy achieve order at or below minus 12 degrees centigrade (-12 C, equal to =10.4 Fahrenheit).

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