Cu-Ni-Fe alloys studied are independent of the interlamellar spacing and independent of the volume fractions of the two chemically different lamellae present; however, they are directly proportional to the differences in cubic lattice parameters of the two kinds of plates forming the lamellar structure.

The lamellar microstructures are produced from supersaturated solid solutions by a demixing process. That is, atoms of one kind cluster to form one type of lamellae and the remaining atoms cluster to form the other type of lamellae which form during low temperature transformation. Because the average atom sizes are different in the two chemically different lamellae the lamellar plates must be strained in order for coherency to be maintained between the lamellae. On overaging this coherency is lost and the compositions of the two lamellae are given by the positions of the phase boundary lines on the equilibrium diagram. However, when coherency is maintained, it is shown in the present work that the demixing process is stopped short of completion at low temperatures such that the compositions of the two lamellae are not given by the equilibrium diagram.

Microfilm $3.00; Xerography $3.00. 53 pages.

COMPRESSION OF MERCURY TO HIGH PRESSURE

(Order No. 66-14,966)

Lance Alan Davis, Ph.D.
Yale University, 1966

A method for calculating volume results from high pressure acoustic data has been developed which is not limited to small compressions by the assumption of a constant ratio of isothermal to adiabatic compressibility. This method thereby extends the useful range of the ultrasonic technique for determining compression data.

In order to demonstrate the technique, high pressure sonic velocity experiments have been performed as a function of temperature on liquid mercury. The apparatus and techniques necessary for determining the velocity of sound in the Hg and for generating and measuring high pressures were developed. A variant of the pulse-echo technique was used to determine the sonic velocity. A supported cylinder-and-piston pressure apparatus was constructed which is capable of attaining pressures of about 25kb. The Hg sample was held in a small stainless steel container which was inserted in the 1 in. bore of the pressure vessel. Pressure was determined by monitoring the resistance of a coil of Au - 2.1% Cr wire which was calibrated for pressure against a dead weight tester.

The volume data obtained have been analyzed to determine the functional form of the equation of state of liquid Hg. It is found that the equation of state is most appropriately written as an expansion of P either in terms of $\frac{V_o}{V}$ or in terms of lnV.

Microfilm $3.00; Xerography $5.20. 104 pages.

NEUTRON IRRADIATION OF PURE METALS AND Al-Zn ALLOYS.

(Order No. 66-13,997)

James Albert Horak, Ph.D.
Northwestern University, 1966

Director: Professor M. E. Fine

The purpose of this investigation was to determine:

1. The source of the anomalous electrical resistivity rise during the beginning of neutron irradiation of metals near 4°K.
2. The induced electrical resistivity as a function of neutron dose for pure metals and dilute aluminum-zinc alloys irradiated near 4°K in a pure fission neutron spectrum.
3. Whether the defects that are mobile below 77°K have an effect on G. P. zone formation in aluminum-zinc alloys.
4. The isochronal annealing stage in which G. P. zones form and grow in aluminum-zinc alloys and the relationship between this process and the annealing behavior of pure aluminum.
5. The role of irradiation-induced lattice defects in G. P. zone formation and growth in aluminum-zinc alloys, especially after reversion where the initial defect concentration is small.

Pure Metals

1. The initial resistivity increase that occurs in the low temperature neutron irradiation of metals is thermal in nature and appears to be due to gamma ray heating.
2. The irradiation-induced resistivity, ρ_i, as a function of irradiation time, t, at about 4.5°K obeys the equation

$$\rho_i = A\ (1 - e^{-\alpha t}) + Bt\ e^{-\beta t}$$

where A, B, α, and β are experimentally determined parameters for each element. The first term represents the production of the displacement cascades that are thought to be vacancy rich regions surrounded by interstitial rich regions. The second term is thought to be due to stable defect clusters or dislocation loops that are produced by the interactions of the displacement cascades.

The irradiation effects in the Argonne VT-53 cryostat are due to fission neutrons with the damage rate being thirteen times that of the Oak Ridge Hole 12 cryostat and one-fifth that of the Munich FRM facility. Of the observed irradiation damage in copper, at the latter facilities, 20 percent is due to thermal neutrons. For silver thermal neutron damage approaches 60 percent of the total damage for these two facilities.

Aluminum and Aluminum-zinc Alloys

The residual resistivity increase rate as a function of irradiation time near 4°K is the same for aluminum and the aluminum-zinc alloys studied. This indicates that the defect production mechanism is the same in the pure metal and in the alloys and that no clustering of zinc atoms to form G. P. zones occurs during the irradiation.

3. The defects which are mobile below 77°K do not appear to have an effect on G. P. zone formation and growth in aluminum-zinc alloys.
4. The formation and growth of G. P. zones begins at the same isochronal annealing temperature as the start of Stage III recovery in pure aluminum. This suggests that the same lattice defect is responsible for both processes. Since it is rather well accepted that the lattice vacancy is responsible for the enhanced formation of G. P. zones after quenching, it appears

* *The items following each abstract are: the price of a microfilm copy; the price of a copy enlarged by the xerographic process to approximately 6 x ½ inches; the number of pages in the manuscript.* Please order copies by order number and author's name.