AEC-NASA TECH BRIEF

Superconductivity in Zirconium–Rhodium Alloys

The phenomenon of superconductivity in zirconium–rhodium alloys at cryogenic temperatures has been studied at Argonne National Laboratory.

In the work, metallographic studies and transition temperature measurements were made with zirconium–rhodium alloys that had been isothermally annealed and water-quenched. The results clarify both the solid-state phase relations at the Zr-rich end of the Zr–Rh alloy system and the influence upon the superconducting transition temperature, T_c, of structure and composition. The data clearly demonstrate that superconductivity in the Zr–Rh system is sensitively dependent upon both composition and structure. For martensitic α, ω, and β phases, T_c increases with increasing Rh concentration. Rhodium is only slightly soluble in α-Zr, if at all, and thus has little or no effect on the transition temperature of the α phase. An intermediate phase, Zr_2Rh, has a T_c equal to 10.8°K, while another phase, ZrRh, is normal down to. 1.7°K.

Alloys were prepared from zirconium crystal bar and 99.9+% pure Rh by arc-melting on a water-cooled hearth in an inert gas atmosphere. The alloys were then given a homogenization heat treatment for 72 hours at 1000°C and water-quenched. Specimens were then cut from the homogenized castings and isothermally annealed at temperatures between 600° and 1200°C for 72 to 168 hours. For all heat treatments, the specimens were wrapped in zirconium foil and sealed in an inert gas atmosphere inside quartz capsules. After all heat treatments, the alloys were quenched by breaking the capsules under water. The phases present in the quenched alloys were identified by optical and X-ray metallography. Diffraction patterns were obtained with a 114.6 mm-diameter Debye–Scherrer camera using either CuK-α or CrK-α radiation. The lattice parameters of the Zr_2Rh and ω phases were determined by a least-squares computer program. Superconducting transition temperatures were determined from magnetic permeability measurement in a 10 oersted field.

Notes:

1. The study, "Superconductivity in Zirconium–Rhodium Alloys," has been published in a Technical Note, by S. T. Zegler, *J. Phys. Chem. Solids*, Pergamon Press, 1965, vol. 26, p 1347–1349.
2. This study may be of widespread interest, since superconductivity has application in ore beneficiation; chemical, physical, medical, and biological research; and electronic devices.
3. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B69-10010

Source: S. T. Zegler
Metallurgy Division
Argonne National Laboratory
(ARG-10223)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
9800 South Cass Avenue
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Category 03