APPOINTMENTS

Jerome M. Pollack, acting president, Fairleigh Dickinson University, to president. . . . **Max Milam**, former chairman, political science department, University of Arkansas, to president, University of Nevada, Reno. . . . **Pauline Jewett**, professor of political science, Carleton University, to president, Simon Fraser University. . . . **Frank Newman**, director, university relations, Stanford University, to president, University of Rhode Island. . . . **Mortimer H. Appley**, associate provost, University of Massachusetts, to president, Clark University. . . . **Richard W. Lounsbury**, professor of geology, Memphis State University, to chairman, geology department at the university. . . . **Mark N. Christensen**, vice-chancellor, University of California, Berkeley, to chancellor, University of California, Santa Cruz. . . . **Philip M. Rice**, dean, College of Language and Literature, University of South Florida, to dean, Graduate School, University of Connecticut.

RESEARCH NEWS

Niobium-Germanium: Becoming a Practical Superconductor

Last month scientists at the Los Alamos Scientific Laboratory, Los Alamos, New Mexico, reported that they have made several large samples of niobium-germanium (Nb_3Ge) which remained superconducting at temperatures above the boiling point of liquid hydrogen (20.4°K at 1 atmosphere). Subsequently, it was learned that researchers at Westinghouse Research Laboratories, Pittsburgh, Pennsylvania, have also accomplished this feat. In both laboratories, the samples were made by a process known as chemical vapor deposition, in which gaseous compounds of niobium and germanium react at elevated temperatures to form a superconducting compound on a metallic or insulating substrate. Chemical vapor deposition is a process that lends itself to fabricating superconductors in commercial quantities.

In recent years, there has been a search for new superconducting materials that remain superconducting at higher and higher temperatures (have higher transition temperatures) because the electrical properties of superconductors are enhanced when the transition temperature is high and because the cost of refrigerating the superconductor is decreased when the operating temperature is increased. In particular, scientists have been enthralled with the idea of finding a superconductor that could be operated in liquid hydrogen, which is a cheaper and a more efficient refrigerant than the present coolant, liquid helium (whose boiling point is 4.2°K at 1 atmosphere).

It was just about a year ago that J. R. Gavaler of Westinghouse caused a stir in the superconductivity community by announcing he had made Nb_3Ge that was superconducting at temperatures above 22°K (*Science*, 25 January, p. 293). However, Gavaler's compound was prepared by the sputtering process, which usually is not easily adaptable to fabricating large amounts of material in the thicknesses needed for devices that carry high electrical currents, oftentimes in high magnetic fields. Thus, while the record Nb_3Ge caused a great deal of excitement among scientists because of the potential for operating a device in liquid hydrogen, it did not appear likely that any such device would be immediately forthcoming. (Investigators in at least three other laboratories have verified the Westinghouse results by sputtering their own Nb_3Ge films with high transition temperatures.) Now, however, that Nb_3Ge with transition temperatures up to 21.5°K has been produced by chemical vapor deposition, it appears that this compound is nearing the point where it can be developed for at least some practical applications, such as superconducting power transmission lines or high field superconducting magnets. Other applications, such as rotating electrical machinery, are likely to be farther off.

The superconductor made at Los Alamos (by L. R. Newkirk and F. A. Valencia) was in the form of a deposit 25 to 50 micrometers in thickness in a copper tube 38 centimeters long. In the chemical vapor deposition process, niobium pentachloride and germanium tetrachloride are carried in a stream of hydrogen gas over a copper tube, which is held at an elevated temperature. The temperature of the tube is such that the niobium and the germanium react to form the Nb_3Ge compound on the copper substrate ($6\ NbCl_5 + 2\ GeCl_4 + 19\ H_2 \rightarrow 2\ Nb_3Ge + 38\ HCl$). According to M. G. Bowman, who headed the Los Alamos effort, the velocity of the gas flow, the concentration of the niobium and germanium species in the gas, and the temperature of the copper are all important in determining the optimum conditions for the preparation of the superconductor with high transition temperatures. The temperature is important because, as was shown conclusively in the earlier work on the compound prepared by sputtering, Nb_3Ge with the stoichiometric ratio of three niobium atoms to one germanium atom and with an ordered crystal structure can only be prepared by depositing the material at elevated temperatures in the range 700° to 1000°C.

H. Laquer and R. Bartlett of Los Alamos have made some preliminary measurements of the properties of the new material. They found, for example, that samples prepared by longitudinally sawing a 6-centimeter length of superconductor-covered tube in two could carry a current of 75,000 amperes per square centimeter at a temperature of 18.1°K. This value is sufficiently high to merit further consideration of the vapor deposited Nb_3Ge, according to one maker of commercial superconducting devices. However, Laquer and Bartlett also found that the superconducting transition temperature was not uniform along the length of longer samples, increasing by about 1°K over a distance of 15 to 22 centimeters. Viewed positively, the lack of uniformity can be taken to signify that further improvements in performance are possible. On the other hand, a uniform material is required over lengths much longer than this in applications such as the long distance, high capacity, direct current (d-c) superconducting power transmission lines that Los Alamos is working on.

For some time, Richard Stevenson