SUPERCONDUCTIVITY IN MOLYBDENUM

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We have discovered that pure molybdenum becomes superconducting at about 1°K. Until now the superconducting transition elements have been separated into distinct groups on the right- and left-hand side of column VI of the periodic table. The present work shows that there is probably a continuous range of superconductivity throughout the whole of the periodic system within both transition and nontransition elements.

By measuring different samples from different sources prepared in different ways we have shown that the observed transition is characteristic of pure bulk molybdenum. We have obtained superconducting molybdenum in two ways: (1) by heating molten pellets of between 0.2 and 0.3 g of molybdenum for a rather long time in an arc furnace, and (2) by using samples prepared from a single crystal of electron-beam-melted, float-zone-refined molybdenum grown by Buehler.

The transitions were followed by noting the change in resonant frequency of a coil surrounding the sample which was immersed in liquid He^3. The results are tabulated in Table I. Presumably previous workers[1] have failed to find superconductivity in this element because of the presence of one or more trace impurities. For instance, Matthias, Clogston, et al.[2] found that iron reduced the transition temperature of Mo-Re alloys in a very drastic way. If the same linear relation between iron concentration and transition temperature holds for pure Mo as is found in Mo-Re alloys, then a concentration of Fe of about 0.02% would be sufficient to suppress the transition to below 0.1°K. An iron concentration smaller by a factor of 3 is indicated in the qualitative spectroscopic analysis received from the supplier with sample No. 1. This discrepancy may just be due to the inherent inaccuracy of the spectroscopic analysis; more detailed investigations are under way.

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[1]M. Strongin and H. A. Fairbank, Proceedings of the Seventh International Conference on Low-Temperature Physics, 1960 (University of Toronto Press, Toronto, 1960; E. Mendoza and J. G. Thomas, Proceedings of the International Conference on Low-Temperature Physics, edited by R. Bowers (Oxford University Press, New York, 1951).

[2]B. T. Matthias, M. Peter, H. J. Williams, A. M. Clogston, E. Corenzwit, and R. C. Sherwood, Phys. Rev. Letters 5, 542 (1960).

Table I. Summary of results.

	Supplier	Transition temperature (midpoint) (°K)	Temperature spread (75% of signal)
(1)	Johnson Matthey. "Specpure" quality, measured as received. The measurements showed the ac resistance of this sample to be at least several-fold greater than the rest of the samples.	none	none
(2)	Johnson Matthey. "Specpure," molten 15 sec in arc furnace.	0.58°	0.05°
(3)	Johnson Matthey. "Specpure," molten 3 min in arc furnace.	0.88°	0.01°
(4)	Johnson Matthey. "Specpure," molten 3 min in arc furnace.	0.98°	0.025°
(5)	Wah Chang. Molten 12 min in arc furnace.	0.97°	0.015°
(6)	Electron-beam-melted single crystal; lead end.	0.95°	0.04°
(7)	Electron-beam-melted single crystal; tail end.	0.94°	0.12°