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Professor T. H. Geballe (PI)

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The important issue of how the superconducting transition temperature T_c in disordered systems changes near the M-I transition where strong localization ($k_F l \sim 1$) is expected has been studied in the Mo-Ge system. In the high Mo concentration, which is in the weakly localized regime, T_c decreases linearly with decreasing Mo concentration from 7.5°K (78 at.% Mo) at a rate of ~ 0.18° K/at.% Mo. In this region the ratio of electron-phonon coupling constant λ to the bare density of states $N(0)$ is constant, which is consistent with the Varma-Dynes tight-binding model. An extrapolation of the linear behavior of T_c in this regime yields the disappearance of T_c near 35 at.% Mo. However, measurements show that T_c exists down to 13.5 at.% Mo. A non-superconducting metallic phase is found to exist between 13.5 at 10.1 at.% Mo at which concentration the insulating phase occurs. — RRH

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Abstract (Cont.)

Superconductivity in very thin films of niobium has been investigated. By use of the ion gun which has been installed in the evaporator it has been possible to identify 3 separate mechanisms which contribute to the reduction in T_c as the film thickness is decreased, namely lifetime broadening, proximity effect and localization. Then upon elimination of the first two, the effect of localization in the weakly localized limit is found to agree quantitatively with theory except for ≤ 15 Å where the fall off of T_c is less than expected.

A small single grid ion source has been constructed in order to promote the growth of metastable films at low temperatures. A high flux of N_2^+ at energies as low as 20 eV has been achieved. Studies indicate that the ion beam promotes the growth of single crystal A15 compounds at lower temperatures. Preliminary studies on the growth of transitor metal nitrides have been initiated.

Progess has been made on a new ultra high vacuum M.B.E. evaporator being constructed at Stanford with funds from the DOD Instrumentation Program. A vendor has been selected and a purchase order made for the design-study of the load-lock/transfer arm and substrate configuration. This is the most sensitive and critical part of our unique concept of load-locking and transferring the complete substrate configuration into and out of the evaporation chamber. Sputtering of molybdenum disulfide onto the disassembled parts – balls, races, and retainers has been chosen as the first step in improving the reliability of the ball bearings used in the present method of evaporation rate control.

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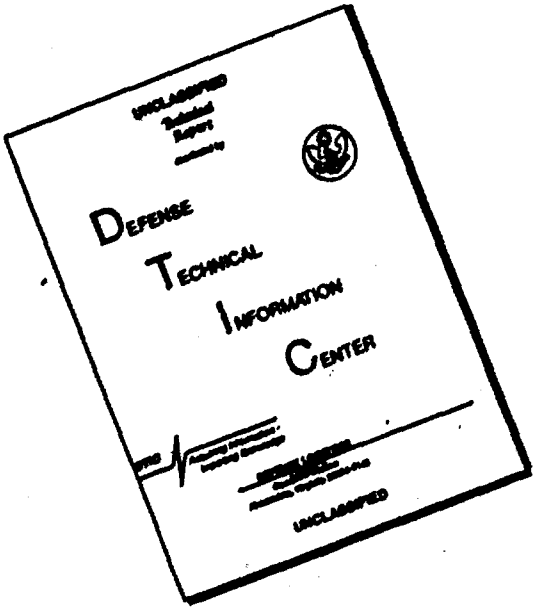

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INTERIM TECHNICAL REPORT

FOR

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

Contract No. F49620-82-C-0014

1 October 1984 - 31 March 1985

SUPERCONDUCTING THIN FILMS, COMPOSITES AND JUNCTIONS

By

Professor T. H. Geballe
Principal Investigator

Department of Applied Physics
Stanford University
Stanford, California 94305

G. L. Report ____

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August 1985

PUBLICATIONS

(1 October 1984 - 31 March 1985)

1. "Further Investigations of Solid-Liquid Reaction and High-Field Critical Current Density in Liquid-Infiltrated Nb-Sn Superconductors," by M. Hong, D. M. Maher, M. B. Ellington, F. Hellman, T. H. Geballe, J. W. Ekin and J. T. Holthuis to appear in the Proceedings of the Applied Superconductivity Conference, San Diego, CA 9/84.

2. "The Effect of Non-Hydrostatic Strain on the Superconducting Properties of In-Situ Formed Cu-Nb_3Sn Filamentary Composites," by J. Bevk, W. A. Sunder, F. Hellman and T. H. Geballe, to appear in the Proceedings of the Applied Superconductivity Conference, San Diego, CA 9/84.

3. "Origin of the B_{c2} Enhancement in Ternary Nb-Sn Phases," by R. Bormann, D. Y. Yu, R. H. Hammond, A. Marshall and T. H. Geballe, to appear in the Proceedings of the Applied Superconductivity Conference, San Diego, CA 9/84.

4. "Phase Transofrmations in Metastable Nb-alloys," by R. Bormann, D. Y. Yu, R. H. Hammond, A. Marshall and T. H. Geballe, to appear in the Proceedings of the Applied Superconductivity Conference, San Diego, DA 9/84.

5. "Specific Heat of Thin Film Amorphous Molybdenum Based Alloys," by D. Mael, W. L. Carter, S. Yoshizumi and T. H. Geballe, accepted to Phys. Rev. B.

6. "Specific Heat of Niobium-Zirconium Multilayers," by P. R. Broussard, D. Mael and T. H. Geballe, Phys. Rev. B 30, 4055 (1984).

7. "Unusual Variability of the Lattice Constant in Polycrystalline Epitaxial Growth of Superconducting A15 Nb-Si," by R. . Feldman, T. H. Geballe, R. L. Opila and S. Celaschi, submitted to Thin Solid Films.

8. "The Metal-Insulator Transition and Superconductivity in Amorphous Molybdenum-Germanium Alloys," S. Yoshizumi, D. Mael, T. H. Geballe and R. L. Greene, submitted to Mott Festschrift. Physics and Chemistry of Disordered Systems and Metal-Insulator Transitions Insulators.

9. "Conversion Electron Mossbauer Study of Thin Nb_3Sn Films," by C. W. Kimball, P. P. Vaishnava, J. L. Matykiewicz, F. Hellman and T. H. Geballe, Bull. Am. Phys. Soc. 30, 608 (1985).

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MATTHEW J.
Chief, Technical Information Division

10. "Strain Mechanisms in Superconducting Nb_3Sn Compounds," J. Bevk, W. A. Sunder, F. Hellman and T. H. Geballe, Bull. Sm. Phys. Soc. 30, 608 (1985).

11. "Magnetron Sputtering of A15 Compound Nb-Sn," by A. D. Kent, F. Hellman, and T. H. Geballe, Bull. Am. Phys. Soc. 30, 608 (1985).

12. "Growth of "Single Crystal" A15 Nb-Sn Thin Films," by F. Hellman, A. F. Marshall and T. H. Geballe, Bull. Am. Phys. Soc. 30, 607 (1985).

13. "Sputtered Niobium-Tantalum Multilayers," P. R. Broussard and T. H. Geballe, Bull. Am. Phys. Soc. 30, 349 (1985).

14. "Microchemical Analysis of High-T_c A15 Structure Films," J. Greggi, J. R. Gavaler and F. Hellman, Bull. Am. Phys. Soc. 30, 608 (1985).

15. "Epitaxy and Texture of A15 Films on Sapphire," by A. F. Marshall, F. Hellman and B. Oh, to appear in the Proceedings of the Fall MRS Meeting (1984).

16. "Phase Relationships and Superconducting Properties of Ternary Systems Used in the Bronze Process," Rudiger Bormann, Adv. Cryogenic Engineering 30, 659 (1984).

Interim Technical Report - Contract No. F49620-82-C-0014
Period 1 October 1984 - 31 March 1985 (PI: T. H. Geballe)

Visitors and Seminars

1. D. McWhan, AT&T Bell Labs, January 15, 1985

2. D. Mitchell, NSF & LBL, February 7, 1985

3. P. W. Anderson, Princeton University, February 8, 1985

4. S. Schultz, University of California, San Diego, February 21-22, 1985

5. P. Grant, IBM Research, San Jose, February 25, 1985

6. R. Greene, IBM Research, San Jose, February 25, 1985.

7. D. Face, University of California, Berkeley, March 4, 1985.

8. J. Krim, University of Marseille, "Wetting and Non-Wetting of Rare Gases on Au and Graphite: Recent Results" February 21, 1985

9. J. Talvacchio, Westinghouse Research Labos "Recent Thin-Film Research at Westinghouse" April 26, 1985

Interim Technical Report - AFOSR Contract No. F49620-C-0014
Period: 1 October 1984 - 31 March 1985 (PI: T. H. Geballe)

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Ad Hoc Committee for NSF-MRL Directors

Member, Editorial Board of Chinese Physics, AIP

Member, Editor for Materials Letters, North-Holland Publishing Company, The Netherlands

Member, Committee for the American Physical Society International Prize for New Materials

Member, Advisory Board of the Miller Institute for Basic Research in Science

Member, Program Committee for meeting on "Materials and Mechanisms of Superconductivity" in Ames, Iowa 5/29-31/85

Scientific projects are being carried out in close collaboration with industry

R. M. White, Control Data, Minneapolis, MN

J. Boyce, Xerox Corp., Palo Alto, CA

J. H. Wernick, Bell Commun. Res., Murray Hill, NJ
J. M. Rowell, Bell Commun. Res., Murray Hill, NJ
C. W. Hull, Bell Commun. Res., Murray Hill, NJ

M. Hong, AT&T Bell Labs, Murray Hill, NJ
W. P. Lowe, AT&T Bell Labs, Murray Hill, NJ

R. Greene, IBM, San Jose, CA

J. Harper, IBM, Yorktown Heights, NW

A. Braginski, Westinghouse Research Ctr., Pittsburgh, PA

A. Green, Naval Res. Lab., China Lake, CA
V. Rehn, Naval Res. Lab., China Lake, CA

New discoveries, inventions or patent disclosures

NONE

Interim Technical Report - Contract No. F49620-82-C-0014
PI: T. H. Geballe

Persons working on contract during the period
1 October 1984 - 31 March 1985

Hammond, Robert H.	Senior Research Associate
Hellman, Frances	Ph.D. expected Summer 1985
Mael, David	Ph.D. expected Summer 1986
Broussard, Phillip	Ph.D. expected Summer 1986
Park, Sung	Ph.D. expected Summer 1986
Kent, Andrew	Ph.D. expected Summer 1987
Oh, Byungdu	Ph.D. expected Summer 1987