

**METALLURGY**  
*and*  
**MATERIALS**  
**PROGRAMS**



**FY 1972**

**UNITED STATES ATOMIC ENERGY COMMISSION**  
**DIVISION of PHYSICAL RESEARCH**

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METALLURGY  
AND  
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PROGRAMS  
Fiscal Year 1972

July 1972

U. S. Atomic Energy Commission  
Division of Physical Research

## FOREWORD

The Metallurgy and Materials Program constitutes one portion of a wide range of research supported by the AEC Division of Physical Research. Other programs are administered by the Division's Chemistry, High Energy Physics, and Physics and Mathematics Offices. Metallurgy and Materials research is supported primarily at AEC National Laboratories and Universities. The research covers a wide spectrum of scientific and engineering areas of interest to the Atomic Energy Commission and is conducted generally by personnel trained in the disciplines of Solid State Physics, Metallurgy, Ceramics, and Physical Chemistry.

This report contains a listing of all research underway in FY 1972 together with a convenient index to the program.

Donald K. Stevens  
Assistant Director (for Metallurgy  
and Materials Programs)  
Division of Physical Research

## INTRODUCTION

The purpose of this report is to provide a convenient compilation and index of the AEC's Metallurgy and Materials Programs. This compilation is intended for use by administrators, managers, and scientists to help coordinate research and aid in selecting new programs.

The report is divided into Sections A and B, listing all the projects, Section C, a summary of funding levels, and Section D, an index.

Each project carries a number (underlined) for reference purposes. The FY 1972 funding level, title, personnel, budget activity number (e.g. 01-02), and key words and phrases accompany the project number. The first two digits of the budget number refer to either Physical Metallurgy and Ceramics (01) or Solid State Physics (02). The budget numbers carry the following titles:

- 01-01 - Materials, Properties and Processes
- 01-02 - Structure of Materials
- 01-03 - Radiation Damage
  
- 02-01 - Materials Preparation and Characterization
- 02-02 - Crystal Physics
- 02-03 - Energetic Particle Interaction

Section C summarizes the total funding level in a number of selected categories. Obviously most projects can be classified under more than one category and, therefore, it should be remembered that the categories are not mutually exclusive.

In Section D the references are to the project numbers appearing in Sections A and B and are grouped by (1) investigators, (2) materials, (3) technique, (4) phenomena, and (5) environment.

It should be recognized that it is impossible to include in this report all the technical data available for such a large program. By the time it could be compiled it would be outdated. The approach taken here was to summarize each project with key words and phrases reflecting the activity under the project. The best method for obtaining more detailed information about a given research project is to contact directly the investigators listed.

Louis C. Ianniello  
Metallurgy and Materials Programs  
Division of Physical Research

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## SECTION A

### Laboratories

The information was taken from current Laboratory program budget submissions. Most projects are of a continuing nature although specific problems and some projects were concluded in FY 1972.

## AMES LABORATORY

Iowa State University

Ames, Iowa 50010

Phone: Area Code 515 284-4000

Metallurgy Division -01-

M. S. Wechsler - Phone: 294-1821

1. MECHANICAL BEHAVIOR \$107,000 01-01  
D. T. Peterson, T. E. Scott

Relation between metallurgical structures and the strength and ductility of metals and alloys, dispersed particle strengthening in Cu-Co, hydrogen embrittlement in V, alloy hardening due to N and Zr in Th, deformation of Y and rare earth metals, precipitation hardening in V, dispersed particle strengthening in Th-Cr Th-Zr-C, creep and fatigue studies of refractory metals with H.

2. METAL PURIFICATION AND IMPURITY \$122,500 01-01  
EFFECT STUDIES  
O. N. Carlson, D. T. Peterson,  
F. A. Schmidt

Development of new methods or the improvement of existing ones for the preparation of ultra-high purity metals of interest to the field of nuclear technology, V Th Mo, purification by electrotransport, metallothermic reduction of purified  $\text{ScCl}_3$ , purification of Mn.

3. CERAMICS RESEARCH \$122,500 01-01  
M. F. Berard, O. Hunter,  
D. R. Wilder

Studies of refractory oxides and other ceramic materials, thermal and mechanical properties, diffusion,  $\text{HfO}_2$ ,  $\text{Y}_2\text{O}_3$ , rare earth oxides, thermal diffusivity and conductivity of  $\text{Er}_2\text{O}_3$   $\text{Al}_2\text{O}_3$ , interdiffusion in  $\text{CaF}_2$ - $\text{SrF}_2$   $\text{Er}_2\text{O}_3$ - $\text{HfO}_2$ , elastic properties of rare earth oxides stabilized with  $\text{WO}_3$  and  $\text{MoO}_3$ .



## AMES LABORATORY

Metallurgy Division -01- (Continued)

4. PHYSICOCHEMICAL PROPERTIES \$271,500 01-02  
 D. M. Bailey, P. Chiotti,  
 K. A. Gschneidner, F. X. Kayser,  
 O. D. McMasters, J. F. Smith,  
 D. E. Williams

Crystallographic, thermodynamic, elastic, magnetic properties, rare earth metals and alloys, alkaline earth metals, alloys of Th Fe Zn Mg Pb and In, high temperature heat content of EuO, EuS, EuSe, EuTe, low temperature specific heat of rare earth compounds and alloys, elastic constants of Pb-Tl-Bi alloys, correlation between elastic behavior and superconductivity in La, morphology of martensite phases in Fe-Ni alloys using neutron scattering.

5. DIFFUSION AND TRANSPORT PROPERTIES \$181,000 01-02  
 O. N. Carlson, D. T. Peterson,  
 F. A. Schmidt, J. D. Verhoeven

Diffusion, solute redistribution during solidification, electrotransport, thermotransport, electrotransport in Hg-Cd alloys, composite-to-dendrite transition in Sn-Pb alloys, electrotransport of C in Mo, effect of magnetic field on eutectic solidification in Sn-Cd and Al-Cu, electrotransport of N in Fe, C O N in U and Sc, C in Ti Cr and Nb.

6. PROPERTIES OF SURFACES \$ 36,500 01-02  
 R. K. Trivedi

Properties, structure, energetics and kinetics of metallic surfaces and interfaces, LEED-Auger analysis of refractory metals, surface energy and atomic mobility in V, epitaxial formation of thin films, surface diffusion in BCC metals, growth of dendritic interfaces.

7. RADIATION DAMAGE \$143,000 01-03  
 C. W. Chen, M. S. Wechsler

Neutron irradiation studies using the Ames Research Reactor, liquid N<sub>2</sub> irradiation facility, interaction between radiation produced defects and interstitial impurities in V, void formation, voids in quenched or irradiated Ni, effect of O on dislocation channeling in V, resistivity, internal friction, yielding, fracture, and transmission electron microscopy.

## AMES LABORATORY

Physics Division -02-

R. G. Barnes - Phone: 294-5442

8. MATERIALS, PREPARATION  
AND CHARACTERIZATION \$155,000 02-01  
F. H. Spedding, G. Burnet

Methods of preparing rare earth metals in purified and single crystal form, physical, electrical, magnetic and thermodynamic properties, La reduction of Dy<sub>2</sub>O<sub>3</sub>, elastic constants of Pr, enthalpies of the rare earth fluorides, solubility of H in rare earth metals, thermal expansion of Pr, alloying behavior of Sm and Tm in Yb and Eu, single crystals of Zn, crystals of Te compounds.

9. ELECTRONIC STRUCTURE AND  
MAGNETIC PROPERTIES OF METALS \$170,500 02-02  
S. Legvold, S. H. Liu,  
J. L. Stanford, L. Hodges,  
R. P. Gupta

Electronic properties of metals and their relation to the magnetic properties, band structure and Fermi surface of Mo, spin-wave behavior in Tb, infrared studies of Cr-Al alloys, Fermi surface of Tl using the RFSE technique, dHvA effect in Mo, energy band calculations for metallic compounds, magneto-elastic waves in heavy rare earths, virtual bound states in V, ferromagnetic resonance in SmCo<sub>5</sub>-class alloys, Seebeck coefficients of dilute magnetic alloys of the 3d transition metals in Cu down to 1 K.

10. NUCLEAR RESONANCE IN SOLIDS \$113,000 02-02  
R. G. Barnes, D. R. Torgeson

Nuclear hyperfine interactions in solids, NMR, NQR, NGR, inter-metallic compounds, characterization of the nuclear environment and measurement of the nuclear electric quadrupole interaction, NGR of <sup>57</sup>Fe in monoborides, deuteron NMR in transition metal deuterides and organic solids, hyperfine-enhanced NMR in Tm intermetallics, NMR to characterize H sites in transition metal hydrides, microscopic nature of the magnetic transition in magnetic intermetallic systems.

## AMES LABORATORY

Physics Division -02- (Continued)

11. SUPERCONDUCTIVITY \$128,000 02-02  
     J. R. Clem, D. K. Finnemore,  
     J. E. Ostenson

Laminar structure compounds, effect of magnetic impurity scattering in superconductors, interaction between quantized vortices, theoretical studies of energy dissipation accompanying flux motion, pressure effect measurements in NbS<sub>2</sub> and NbSe<sub>2</sub>, theoretical models describing the pinning of magnetic flux in superconductors, thermal conductivity measurements to determine the superconducting energy gap, electron-phonon interactions in superconducting materials with highly anisotropic chemical binding.

12. LOW TEMPERATURE, HIGH \$143,500 02-02  
     PRESSURE STUDIES  
     C. A. Swenson, D. Guban,  
     M. S. Anderson

Thermodynamic properties of solids, equations of state, thermal expansions, specific heat, inert gas solids, low temperature thermal expansion of Ne, heat capacity of A Kr and Xe, low temperature thermal expansion of solid H and D, low temperature thermodynamic data for Ca Ba and Sr.

13. TRANSPORT PROPERTIES OF SOLIDS \$171,000 02-02  
     G. C. Danielson, P. H. Sidles,  
     H. R. Shanks

Transport properties in both crystalline and amorphous materials, switching processes in chalcogenide glasses, magnetic susceptibility and heat capacity of Na<sub>x</sub>WO<sub>3</sub> WO<sub>3</sub> and ReO<sub>3</sub>, Te-As-Ge semiconducting glass, superconductivity in transition metal oxides and chalcogenides, sputtering method to prepare amorphous materials.

## AMES LABORATORY

Physics Division -02- (Continued)

14. OPTICAL PROPERTIES OF SOLIDS \$156,000 02-02  
 D. W. Lynch, C. G. Olson,  
 R. Fuchs, K. L. Kliewer,  
 R. H. Good

Experimental and theoretical research on the optical properties of metals, alloys and insulators, optical studies on Cd Cr Ni Pt Be Cr<sub>2</sub>O<sub>3</sub> Nb NiS KCl using synchrotron radiation, infrared absorption in Zn Be Pt Rh, thermomodulation studies in Al Cu Au, Stark effect of excitons in TlCl, theory of p-polarized optical properties of metals, magnetic field effects on optical properties, surface plasmon dispersion curves.

15. LATTICE DYNAMICS AND NEUTRON SCATTERING IN SOLIDS \$333,500 02-02  
 S. K. Sinha, C. Stassis,  
 J. G. Traylor, G. Kline,  
 R. P. Gupta

Neutron scattering from FCC <sup>4</sup>He, phonon dispersion curves for Si Ge α-Sn and diamond, excitations in the quantum solid paradeuterium and solid nitrogen, polarized neutrons to study the spatial distribution of trapped electrons around color centers in alkali halide crystals, Cr, liquid crystals, nuclear ordering at low temperatures.

16. OPTICAL AND MAGNETIC PROPERTIES OF RARE EARTH SALTS, SOLUTIONS, METALS AND ALLOYS \$243,500 02-02  
 F. H. Spedding, R. H. Good,  
 W. J. Haas

Laser Raman spectra, absorption spectra, electrical resistivity, heat capacity, magnetic susceptibilities, magnetic structures of rare earth solids and liquid solutions, low temperature absorption spectra and Zeeman effect of Er and Ho fluoride and Er and Dy ethylsulfate, Raman experiments on solutions containing La Gd and Lu nitrate, electrical resistivity and thermal conductivity of alloy systems of Dy Ho and Er with Lu.

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 Argonne, Illinois 60439  
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Materials Science Division -01-

P. G. Shewmon - Phone: 739-2221

N. L. Peterson - Phone: 739-2222

17. PHYSICAL METALLURGY \$389,000 01-01  
 M. B. Brodsky, A. J. Arko,  
 J. J. Rechten

Electronic structure of actinide metals, alloys and compounds, defect structure in actinide compounds, low temperature specific heat measurements on Pu-242 and Np, local magnetic moment formation in alloys of Mg-Pu Mg-Np Pd-Am, magnetic susceptibility in compounds of Pu-U-Al<sub>2</sub> series, NGR in Pu-242 compounds, neutron diffraction on PuPd<sub>3</sub>, resistivity at high pressures, Fermi surface of Tc and Mo, self-radiation damage in PuO<sub>2</sub> using high frequency mechanical damping measurements.

18. METAL PHYSICS \$363,000 01-01  
 N. L. Peterson, Wei-Kong Chen,  
 E. S. Fisher, J. N. Mundy,  
 S. J. Rothman, D. G. Westlake

Atomic mechanisms of self-diffusion and impurity diffusion, effect of H on the mechanical and physical properties of transition metals, pressure dependence of elastic moduli and magnetic susceptibility, self diffusion in Na and Cr, impurity diffusion of Ag in Sn, Cu in Pb, Zn in Al, effect of irradiation on self diffusion in Ag and Cu, diffusion in metal oxides NiO FeO NiO-CoO, diffusion of H isotopes in Nb, effects of D on the ductility and elastic constants of V Nb and Ta, characterization of V-H and V-D systems, effect of pressure on the elastic moduli of Hf Ru Re Gd Dy Er, effect of pressure on the magnetic susceptibility of U.

19. MECHANICAL PROPERTIES \$228,000 01-01  
 U. F. Kocks, R. O. Scattergood,  
 E. S. P. Das

Theoretical and experimental research on fundamental aspects of crystal plasticity and mechanical properties of materials, computer modeling of dislocation interactions, dislocation dipole structures, work hardening and dynamic recovery, crack propagation in Cu single crystals under cyclic loading, structure characterization of deformed Cu crystals.

## ARGONNE NATIONAL LABORATORY

Materials Science Division -01- (Continued)

20. KINETIC STUDIES \$198,000 01-01  
 H. Wiedersich, J. W. Miller,  
 F. V. Nolfi, Jr.

Investigations into forces and mechanisms that lead to the formation of defect aggregates, precipitates and other inhomogeneous distributions of atoms in solids, precipitation of He in Cu, location of Au atoms in Sn from channeling experiments, clustering of Au interstitials in Sn, thermodynamics of stressed solids and the effects of stress and temperature gradients on substitutional diffusion, nucleation theory for solids under irradiation, field-ion atom probe.

21. ALLOY PROPERTIES \$658,000 01-02  
 J. B. Darby, Jr., A. T. Aldred,  
 F. Y. Fradin, G. S. Knapp,  
 D. J. Lam, F. M. Mueller,  
 B. W. Veal, Jr.

Electronic structure of metals with emphasis on actinides and superconducting alloys, alloy chemistry and phase relations in binary compounds of Np and Am, magnetic properties of actinide compounds, NMR on NpP NpSn<sub>3</sub> and PuSn<sub>3</sub>, optical studies, x-ray induced photoemission spectroscopy, theory of superconductivity, specific heat studies of superconducting materials, resonance studies in transition metal superconductors, studies of the superconducting compound Li-Ti-S, magnetic-moment distributions in ferromagnetic alloys, optical reflectivity in ZrZn<sub>2</sub>, positron annihilation in Nb-Mo.

22. SCATTERING STUDIES \$491,000 01-02  
 M. H. Mueller, G. H. Lander

Magnetic scattering of neutrons from materials with localized atomic moments, low temperature x-ray scattering, binary U compounds, UAs-UP UN-UC, NpPd<sub>3</sub>, PuAl<sub>2</sub>-UAl<sub>2</sub>, polarized neutron experiments on rare earth metals and compounds, V deuteride and hydride, magnetic and structural transitions in Fe<sub>3</sub>O<sub>4</sub> MnSi, defect structure in CeO<sub>2</sub>, crystal structure of CuCl.

## ARGONNE NATIONAL LABORATORY

Materials Science Division -01- (Continued)

23. RADIATION EFFECTS \$419,000 01-03  
T. H. Blewitt, A. C. Klank,  
B. A. Loomis, T. L. Scott

Point defect production, annihilation and clustering, factors influencing void formation, radiation effects in superconductors, radiation sources include the CP-5 low temperature facility, 4 MeV Dynamitron and plan to use LASL meson facility, radiation effects in Nb, ordering in Cu<sub>3</sub>Au, impurity-interstitial binding energy, magnetization of Tc as a function of neutron bombardment, flux pinning, replacement collision studies, low temperature irradiation damage and recovery in Cu and Al.

24. CHARGED PARTICLE IRRADIATION STUDIES \$184,000 01-03  
K. L. Merkle

Formation, nature and properties of irradiation induced defect structures in solids, 300 KeV heavy ion accelerator, studies of displacement cascade clusters by TEM in Au, void, bubble and loop contrast, damage density and distributions in heavy ion bombardment, migration and clustering of defects and impurities in He irradiated Au.

Solid State Science Division -02-

O. C. Simpson - Phone: 739-3141

25. MATERIALS PREPARATION AND CHARACTERIZATION \$101,000 02-01  
S. Susman, D. Hinks

Preparation of metal insulator and semiconductor single crystals with documented physical and chemical characteristics, KCN, NaCN, LiCl, KCl, Class 10 clean room, rare earth oxides, Er<sub>2</sub>O<sub>3</sub>, purification by halogen and hydrohalogen gases.

ARGONNE NATIONAL LABORATORY  
Solid State Science Division -02- (Continued)

26. NEUTRON SCATTERING STUDIES \$596,000 02-02  
 G. Felcher, D. L. Price,  
 J. M. Rowe, T. Worlton

Slow neutron inelastic scattering, neutron diffraction of magnetic systems, high pressure neutron diffraction, 3 beam facilities at CP-5, thermal neutron T-O-F inelastic scattering facility, crystal diffractometer equipped with a polarizer and high field-low temperature sample environment, high pressure T-O-F diffractometer, KCN, liquid Rb, liquid A, RbBr, glassy carbon, vitreous BeF<sub>2</sub>, TaH, VD, Rb, laser Raman scattering, spatial distribution of d- and f-electrons near the Fermi surface in Cr Pd Ce, high pressure neutron diffraction in CoO V<sub>2</sub>O<sub>5</sub> ZrTiO<sub>4</sub> up to 32 Kb.

27. DEFECTS IN NONMETALLIC CRYSTALS \$198,000 02-02  
 P. Yuster, C. Delbecq,  
 D. Schoemaker, S. Susman

Processes which occur during exposure of nonmetallic crystals to ionizing radiation, nature of defects, interaction of defects with the lattice modes of the host crystal and with other defect species, reorientation kinetics of Cl<sub>2</sub><sup>-</sup> in LiCl, absorption bands of heteronuclear molecule-ions FCl<sup>-</sup> FBr<sup>-</sup> and FI<sup>-</sup> in KCl, tunneling character of the restricted interstitial motion of H<sub>A</sub> (Li<sup>+</sup>), stress effect on ESR spectra, infrared absorption spectra from H-center perturbations on the U-center, magnetic and electric field effects on excited states of centers.

28. VERY-LOW-TEMPERATURE STUDIES \$235,000 02-02  
 H. Culbert, J. Ketterson,  
 M. Kuchnir, P. Roach

Studies of the properties of quantum liquids and solids at very low temperatures, specific heats of superconductors, ion motion in <sup>3</sup>He-<sup>4</sup>He solutions and sound propagation in liquid <sup>4</sup>He, pressure and concentration dependence of the spin diffusion and ultrasonic attenuation in <sup>3</sup>He-<sup>4</sup>He solutions, specific heat measurements on La-Ce, magnetic susceptibility of La-10% Ce down to 50 mK, specific heat measurements on Er<sub>2</sub>O<sub>3</sub> glassy carbon and Pb-Tl alloys.



ARGONNE NATIONAL LABORATORY  
Solid State Science Division -02- (Continued)

29. SUPERCONDUCTIVITY STUDIES \$133,000 02-02  
 R. Huebener

Magnetic structures and transport properties, proximity effects, relaxation time for magnetic flux penetration, eddy current damping in thin film superconductors, dynamic behavior of flux structures in Pb films, magneto-optical studies of flux structure, proximity effect studies in Al-Au film structures, effect of laser light on superconductivity.

30. PHASE TRANSITIONS AND CRITICAL PHENOMENA \$281,000 02-02  
 L. Guttman, H. Kierstead, D. O'Reilly

Study of transitions in order-disorder systems, liquid He, ferroelectric materials and antiferroelectric materials, x-ray scattering, neutron scattering, ESR, NMR, gas-liquid critical region in He, thermodynamic properties of  $^3\text{He}$ - $^4\text{He}$  mixtures, light scattering from Ar- $\text{CH}_4$  solutions, critical ordering in  $\text{Fe}_3\text{Al}$ , spin-lattice relaxation times and self diffusion in liquids, ENDOR studies of paramagnetic surface state species.

31. ELECTRONIC AND MAGNETIC PROPERTIES \$336,000 02-02  
 B. Dunlap, G. M. Kalvius,  
 J. Ketterson, L. Windmiller

Mössbauer technique to study magnetic properties and electronic structure, Fermi surface studies,  $^{243}\text{Am}$  in actinide compounds, Yb intermetallics, isomer shifts in Pt-Ir alloys, Np Laves phases, dHvA effect in Au Pd Pt Rh Ir Nb, band calculations on Pd Pt Nb, calculations of pressure dependence of the Fermi surface in Au.

32. ELECTRON SPIN RESONANCE AND KINETIC STUDIES \$233,000 02-02  
 S. Marshall, J. McMillan, B. Smaller

Studies of metal-ion impurities and radiation defects in insulators, microscopic properties of paramagnetic defects in single crystals, primary radical species produced in  $\text{H}_2\text{O}$ , theoretical-experimental correlations for nucleic acid bases, gamma irradiation of Li niobate and Zn pyridine-sulphonate,  $\text{Nb}_2\text{O}_5$ , isotope effect in the g-values of ions in calcite and of  $\text{Gd}^{+3}$  in  $\text{ThO}_2$ , spin lattice relaxation rates of paramagnetic defects in  $\text{CaCO}_3$ ,  $\text{ThO}_2$  and  $\text{MgO}$ , ESR of  $\text{Cr}^{+3}$  in  $\text{MgO}$ , temperature dependence of hyperfine structure splitting of three molecule-ions in  $\text{CaCO}_3$ .

ARGONNE NATIONAL LABORATORY  
Solid State Science Division -02- (Continued)

33. SOLID STATE THEORY \$341,000 02-02  
T. Arai, S. Eckstein,  
T. Gilbert, F. Mueller,  
A. Rahman, J. Robinson,  
D. Smith, D. Connor

Theory of electron correlation at metallic densities, itinerant theory of magnetism and electron correlations, theory of temperature dependence of magnetic ordering in rare-earth metals and alloys, localized moments and the Kondo effect, cumulant perturbation expansion for spins, molecular dynamic calculations, statistical mechanics of computation, theory of neutron scattering measurements, vortex motion in quantum liquids, electron-phonon interactions, structure and interactions of atoms in molecules and solids, optical and electronic properties of insulators, electronic structure and properties of metals, theoretical studies of superconductivity, magnetism of transition metal alloys.

34. ENERGETIC PARTICLE INTERACTION \$206,000 02-03  
J. Jackson, G. Montet,  
W. Primak

Vacancy concentration and specific resistivity of vacancies in quenched Pt, energy release and resistivity during recovery in deformed Ag, recovery of radiation damage in Rh, damage rate in Pt and Rh at intermediate temperatures, ion bombarded Li niobate, radiation blistering.

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Materials Science Department -01-  
 D. H. Gurinsky - Phone: 345-3504

35. SUPERCONDUCTIVITY \$314,000 01-02  
 M. Strongin, M. Garber,  
 D. G. Schweitzer, J. Crow,  
 D. M. Parkin, H. Farrell

Properties of superconductors with emphasis on study of cryogenically deposited thin films, Sn Al and Pb films on Si substrates, fluctuation phenomena in thin films and small particles, effect of surface impurities on the properties of superconducting Nb, hysteresis in superconductors, ac losses in Nb<sub>3</sub>Sn, transition temperature of alloys made by rf sputtering, LEED and Auger analysis.

36. RELATIONSHIP BETWEEN PROPERTIES AND STRUCTURE \$100,000 01-02  
 J. Galligan, M. Suenaga,  
 J. Anne

Dynamic interactions of dislocations with lattice defects and with magnetic flux lines in the normal and superconducting state, interactions of quantized magnetic vortices with lattice defects and the effect on J<sub>c</sub> of hard superconductors, development fabrication and evaluation of high current, high critical temperature multifilamentary A-15 superconductors, Nb, Pb-In, disclinations in Ag whiskers, composites of Nb<sub>3</sub>Sn in Cu and V<sub>3</sub>Ga in Cu.

37. RADIATION DAMAGE \$ 77,000 01-03  
 D. G. Schweitzer, D. M. Parkin

Electron irradiation of multifilament Nb-Ti in Cu superconductor composite, 30 GeV proton irradiation cryostat under construction, electron irradiation of hollow cylinders of type I superconductors.

## BROOKHAVEN NATIONAL LABORATORY

Department of Physics -02-

G. J. Dienes - Phone: 345-3731

NEUTRON SCATTERING STUDIES \$1,439,000 02-02

38. LATTICE DYNAMICS AND  
PHASE TRANSFORMATIONS \$487,000  
G. Shirane, J. D. Axe,  
J. Skalyo, S. Shapiro,  
W. Yelon, B. C. Frazer

Phase transition and acoustic phonons in high temperature superconductor  $Nb_3Sn$ , phase transformations and diffuse scattering in perovskites ( $KMnF_3$ ,  $KNbO_3$ ), ferroelectricity in the rare-earth molybdates and its relation to soft mode displacements and polarization.

39. DYNAMICS OF CONDENSED  
PHASES OF RARE GASES \$245,000  
G. Shirane, L. Passell,  
J. Skalyo

Phonon dispersion in body centered cubic He-4, the scattering of neutrons by rotons in liquid He-4, phonon line shapes and temperature dependent frequency shifts for solid Ne, diffusion of He-3 into liquid He-4.

40. SPIN WAVES AND MAGNETIC  
CRITICAL SCATTERING \$206,000  
G. Shirane, D. Cox,  
J. Skalyo, W. Yelon

Neutron scattering studies of one-dimensional antiferromagnets and anisotropic antiferromagnetic  $FeCl_2$ , spin-wave dispersion studies in  $NiO$  and  $MnPt_3$ , critical behavior of antiferromagnets in magnetic fields for  $FeCl_2$  and  $CuCl_2 \cdot 2D_2O$ .

41. FERROMAGNETIC INSULATORS \$110,000  
L. Passell, G. Shirane,  
W. Yelon

Neutron scattering studies of two isotropic Heisenberg ferromagnets,  $EuO$  and  $EuS$ , spin-wave dispersion and correlations in  $CrBr_3$ .

BROOKHAVEN NATIONAL LABORATORY  
Department of Physics -02- (Continued)

NEUTRON SCATTERING STUDIES (Cont'd) \$1,439,000 02-02

42. MAGNETIC STRUCTURES \$189,000  
 D. Cox, W. Yelon, G. Shirane

Studies of magnetic structures showing linear ordering (CsNiCl<sub>3</sub>, RbNiCl<sub>3</sub>, CsCoBr<sub>3</sub>) and two-dimensional ordering (BaNiF<sub>4</sub>, BaFeF<sub>4</sub>, RbFeF<sub>4</sub>), magnetic ordering in the perovskite Ba<sub>2</sub>MReO<sub>6</sub>, magnetic scattering from the rhombohedral beta-phase of solid O<sub>2</sub>, effect of crystalline electric fields in SmS.

43. COLD NEUTRONS \$202,000  
 L. Passell, G. Shirane,  
 J. D. Axe, B. C. Frazer

In-pile and safety tests for Cold Moderator Project, design and fabrication of basic experimental equipment for the three beams of the cold moderator.

44. THEORY \$148,000 02-02  
 M. Blume, R. E. Watson,  
 R. A. Bari, A. D. Novaco,  
 J. Sivardiere, G. H. Vineyard

Quantum mechanical calculations of magnetic properties and interactions, dynamics of one-dimensional Heisenberg magnets, spin waves in layered magnetic systems, quadrupolar ordering in magnetic crystals, low-spin-high-spin transitions, Ising model for the phase diagram of He-3-He-4 mixtures, magnetic ordering in Cu rich Cu-Ni-Fe alloys, energy band theory of the rare-earth metals, electronic structure of Au alloys, soft x-ray photoemission.

45. SUPERCONDUCTIVITY \$116,000 02-02  
 M. Strongin, J. E. Crow,  
 M. N. Varma

Superconducting cavities and surfaces, fluctuations in thin superconducting films and very small particles, preparation and characteristics of ultra-thin films using low-energy-electron diffraction and Auger spectroscopy, oxide structures on Nb surfaces, films on substrates with favorable exciton bands, excitonic mechanisms of superconductivity.

BROOKHAVEN NATIONAL LABORATORY  
Department of Physics -02- (Continued)

ENERGETIC PARTICLE INTERACTIONS \$781,000 02-03

46. METALS AND ALLOYS \$210,000  
 A. N. Goland, D. M. Parkin,  
 G. J. Dienes

Radiation effects in superconductors irradiated at cryogenic temperatures, positron annihilation at defects, internal friction in Au irradiated at low temperatures, axial channeling in thin films of Si, Ge, and Au, enhanced diffusion in brass during cyclic straining.

47. IONIC CRYSTALS \$218,000  
 P. W. Levy, P. L. Mattern,  
 G. J. Dienes

Radioluminescence of Tl doped KCl during Co-60 irradiation and the configuration coordinate diagram for the system, void and dislocation formation by irradiation in ammonium perchlorate, thermoluminescence of LiF dosimeters.

48. DIFFRACTION STUDIES \$245,000  
 D. T. Keating, A. N. Goland,  
 J. D. Axe, G. J. Dienes

Neutron scattering study of the beta-to-omega phase transformation in Zr-Nb alloys, x-ray and neutron scattering investigation of the forbidden (222) reflection in Si.

49. THEORY \$108,000  
 G. J. Dienes, D. T. Keating,  
 A. N. Goland

Mechanism of point defect formation in ionic crystals by ionizing radiation, x-ray scattering from anisotropic HCP crystals containing interstitial loops, molecular dynamic simulations of shock waves in three dimensions.

ILLINOIS, UNIVERSITY OF  
Urbana, Illinois 61801

R. J. Maurer - Phone: Area Code 217 333-1370

Department of Metallurgy  
and Mining Engineering -01-  
C. A. Wert - Phone: 333-1440

50. MECHANISMS OF SOLID STATE  
TRANSFORMATIONS \$ 41,000 01-02  
C. J. Altstetter

Use of solid electrolytic cells to measure chemical potential difference between saturated and unsaturated oxygen solutions in various metals, study of precipitation of coherent  $V_{16}N$  particles in V, emf measurements on a number of metal-oxygen systems (Ta, V, Fe, Ni) in temperature range 700-1100°C.

51. ELECTRONIC STRUCTURE OF  
TRANSITION METAL ALLOYS \$ 38,000 01-02  
P. A. Beck

Magnetic behavior of  $Au_4Mn$  in the disordered state, magnetic properties of  $Pd_3Mn$ , Fe-Cr Fe-Cr-Al in the composition range where the transition from ferromagnetism to paramagnetism occurs, superconductivity in the Re-rich HCP Re-Co solid solution.

52. POINT DEFECT - DISLOCATION  
INTERACTIONS \$126,000 01-02  
H. K. Birnbaum

Diffusion of H and its isotopes in BCC metals, interaction of H with other lattice defects, effect of H on dislocation motion, anelastic, magnetic and mechanical property tests, high purity Nb, H cluster formation and motion in Nb-H and Nb-O-H alloys, long range diffusivity measurements of H in Nb using the Gorsky effect, low temperature quantum tunneling effect in Nb-H.

53. DISLOCATIONS AND SURFACE BARRIERS \$ 28,000 01-02  
M. Metzger

Mechanical microstrain behavior and dislocation distributions in composite and coated materials, Cu-W composites, matrix dislocation structure, fiber-matrix interaction.

ILLINOIS, UNIVERSITY OF  
Department of Metallurgy  
and Mining Engineering -01- (Continued)

54. STUDY OF ACOUSTIC EMISSION DURING  
 THE PROPAGATION OF STRESS-  
 CORROSION CRACKS \$ 24,000 01-02  
 E. N. Pugh

Mechanism of crack propagation under stress corrosion cracking conditions, acoustic emission and electron microfractography techniques, Mg-Al tested in aqueous chloride-chromate solution, correlation of fractographic information with acoustic emission and crack velocity data.

55. NUCLEAR MAGNETIC RESONANCE STUDIES \$ 75,000 01-02  
 T. J. Rowland

Atomic diffusion mechanisms using NMR techniques, pulsed resonance apparatus for high temperature Al studies, mode and morphology of precipitation in Cu-Be alloys using field ion microscopy, resonance study of O and N dissolved in V.

56. SOLID STATE PHASE  
 TRANSFORMATIONS AND THIN FILMS \$102,000 01-02  
 C. M. Wayman

Phase transformations in both bulk and thin film materials, nucleation and growth mechanisms, crystallographic relationships and atomic movements, growth of sputtered CuAu alloy films, growth of evaporated Cr films, crystal structure analyses for the bainitic and martensitic phases in CuZn, studies of NiAl and NiFe alloy films.

57. THE STUDY OF THE NATURE OF  
 SOLID SOLUTIONS OF METALS \$ 40,000 01-02  
 C. A. Wert

Formation of hydrides and carbides in V and Nb, solid solubility of H in V by internal friction, H in Nb also, trapping of H by dissolved O C N, coherency of carbides in V and Nb, H in V-Ti and V-Cr alloys.



## ILLINOIS, UNIVERSITY OF

Department of Physics -02-

R. J. Maurer - Phone: 333-1370

58. USE OF VERY HIGH PRESSURE TO  
INVESTIGATE THE STRUCTURE OF MATTER           \$105,000     02-02  
H. G. Drickamer

Electronic behavior of solids under high pressure, optical absorption and luminescence to 160 Kbars, electrical resistance to 500 Kbars, x-ray diffraction to 400 Kbars, Mössbauer resonance to 250 Kbars, change of oxidation state of transition metals (Cu, Fe), changes of spin state of Fe, electronic transitions in rare earths and aromatic hydrocarbons.

59. ANHARMONIC EFFECT IN SOLIDS                     \$ 75,000     02-02  
A. V. Granato

Non-linear elastic properties of materials, third order elastic constants of Co-Ni, plastic behavior of superconductors, dislocation inertial model of plasticity in superconductors, measurements of ultrasonic attenuation and deformation.

60. DEFECT AND ELECTRONIC  
PROPERTIES OF SOLIDS                                 \$112,000     02-02  
D. Lazarus

Diffusion mechanisms, thermoelectric properties, magnetic structures, defect and electronic properties of solids up to 10 Kbar pressure and down to 1°K, effect of uniaxial strain on the Fermi surface of Al, self diffusion of Na in NaCl, thermoelectric effects in alkali halides at high pressures and low temperatures.

61. PROPERTIES OF NOBLE GAS CRYSTALS                 \$ 58,000     02-02  
R. O. Simmons

Study of quantum zero-point and anharmonic effects upon the defect structure and lattice dynamics of noble gas crystals, temperature dependence of the x-ray Debye-Waller factors of Ne and Kr crystals, thermal vacancies in Ar, defect structure in HCP <sup>4</sup>He and BCC <sup>3</sup>He, P-V-T measurements on solid Ar.

ILLINOIS, UNIVERSITY OF  
Department of Physics -02- (Continued)

62. NUCLEAR MAGNETIC RESONANCE IN SOLIDS      \$134,000      02-02  
C. P. Slichter

Study of dilute magnetic systems, magnetic and electric couplings of nuclei near impurities for Cu alloys containing V Co Ni, charge density oscillations in K, double resonance experiments on Na in NaCl containing small amounts of Ag, theory of pressure induced chemical changes.

63. PHYSICS OF REFRACTORY MATERIALS      \$ 74,000      02-02  
W. S. Williams

Thermal, mechanical and electrical behavior of transition-metal carbides, effect of Fermi energy on dislocation velocities in doped Ge Si, order-disorder transitions in V carbide, simultaneous heat capacity and temperature coefficient of resistivity measurements of Fe through the Curie point, x-ray topography of dislocations in covalent solids.

64. SOLID STATE PHYSICS; ENERGETIC  
PARTICLE INTERACTION      \$146,000      02-03  
J. S. Koehler

Electron irradiation of metals and semiconductors, anomalous x-ray transmission of irradiated Cu crystals at 15<sup>0</sup>K, transmission of 1 MeV protons through Ag, energy and angular distribution of channeled protons, irradiation of p-type Ge, ac hopping measurements at 2<sup>0</sup>K, electron irradiation of Au and subsequent annealing.

LAWRENCE BERKELEY LABORATORY  
 University of California  
 Berkeley, California 94720  
 Phone: Area Code 415 843-2740

Inorganic Materials Research Division

L. Brewer - Phone: 642-5176

V. Zackay - Phone: 642-3812

65. I. MECHANISMS OF PLASTIC  
 DEFORMATION, II. THERMODYNAMICS  
 OF INHOMOGENEOUS MATERIALS \$ 85,000 01-01  
 J. W. Morris, Jr.

Creep and superplasticity in alloys, computer simulation of thermally activated dislocation glide across a plane containing randomly-distributed obstacles, effect of solute atmosphere on dislocation glide (Ag in Zn), slip behavior of Mo-Re alloys, steady state creep in Al-Mg, transient creep at elevated temperatures, superplastic behavior in Zn-Al, theory of continuous interfaces in one-component fluids, concentration gradient effects in binary solutions, structure and morphology of precipitates.

66. FUNDAMENTALS OF ALLOY DESIGN \$215,000 01-01  
 E. R. Parker, V. F. Zackay

Applications of the principles of materials science to the design of complex multiphase alloys having superior properties, alloys with high toughness and high strength, cryogenic alloys, control of microstructure through chemical composition and processing treatments, steels.

67. RELATION BETWEEN MICROSTRUCTURE  
 AND PROPERTIES: ELECTRON  
 MICROSCOPY AND DIFFRACTION \$200,000 01-01  
 G. Thomas

Structural investigations using electron microscopy and x-ray diffraction, control of properties in materials through characterization and control of structure, structural alloy steels, alloys undergoing spinodal and ordering transformations, oxide systems, toughness due to dislocated or twinned martensites in Fe-Ni-Co alloys, mechanisms of order and substructure characterization in Li spinels and feldspars, in-situ radiation damage using the high voltage electron microscope.

## LAWRENCE BERKELEY LABORATORY

Inorganic Materials Research Division (Continued)

68. MICROSTRUCTURE AND BEHAVIOR  
OF CERAMIC MATERIALS; GLASS  
AND CERAMIC-METAL SYSTEMS                   \$130,000    01-01  
    J. A. Pask

Mechanical behavior of two-phase ceramic material (glass and MgO) at elevated temperatures, creep of MgO with LiF present, freeze-drying technique to prepare fine-grained mixed sulphates of MgO and  $\text{Al}_2\text{O}_3$ , diffusion studies in the  $\text{SiO}_2$ - $\text{Al}_2\text{O}_3$  systems, electrochemical reactions between Fe and liquid glass, crack propagation in brittle transparent materials subjected to high velocity impacts.

69. CRYSTAL IMPERFECTIONS                           \$155,000    01-01  
    J. Washburn

Mechanisms of deformation recovery in MgO, glide and climb of dislocation loops in MgO, field ion microscopy of  $\text{Ni}_4\text{W}$ , correlation of defect structure with electrical properties of ion-implanted Si, atom probe field ion microscopy to study ion bombardment of metals, in-situ studies of voids using HVEM for stainless steel Al Cu-Al and Ni-Co, switching behavior of amorphous glasses, photovoltaic cells.

70. RELATION OF MICROSTRUCTURE  
TO PROPERTIES IN CERAMICS                           \$120,000    01-01  
    R. M. Fulrath

Ceramic materials having structural, ferroelectric, piezoelectric or ferromagnetic properties, hot stage scanning electron microscopy studies of sintering, compositional width of the single phase of  $\text{PbZrO}_3$ - $\text{PbTiO}_3$ , sintering kinetics of  $\text{Pb}(\text{Ti},\text{Zr})\text{O}_3$  and  $(\text{NaK})\text{NO}_3$ , defect structure of Li ferrite, He and Ne diffusion studies in fused  $\text{SiO}_2$ , He through dense  $\text{Al}_2\text{O}_3$ .

LAWRENCE BERKELEY LABORATORY  
Inorganic Materials Research Division (Continued)

71. COMPOSITE MATERIALS AND  
 THEIR ELECTRICAL AND MAGNETIC  
 PROPERTIES AND MECHANICAL PROPERTIES      \$ 70,000      01-01  
 R. H. Bragg

Structure and properties of glassy carbon, small angle x-ray scattering of glassy carbon, pyrolytic graphite and cleaved MgO, tensile properties of Al-B composite materials, kinetics of the graphitization of glassy carbon, structure of unidirectional solidification of eutectics.

72. POWDER METALLURGY      To start      01-01  
 M. R. Pickus      in FY 1973

Superconducting materials, reactive metals, high strength materials, materials with controlled porosity, to explore the use of powder metallurgy techniques to prepare new materials, powder rolling of reactive metal composites (Nb), relative roles of porosity and residual gases on sintered ductility, pyrophoricity of powder Nb.

73. SUPERCONDUCTIVITY EFFECTS -  
 HIGH FIELD SUPERCONDUCTIVITY      \$190,000      01-02  
 L. Brewer, E. R. Parker,  
 V. F. Zackay, M. R. Pickus

Powder metallurgy techniques used to prepare composite superconductors, synthesis of metastable A-15 compounds with potential for high critical temperatures,  $V_3Al$ ,  $Nb_3Si$ , superconducting tape containing  $Nb_3Sn$  filaments, amorphous 5d transition metal alloys and 4d-5d combination by vapor condensation.

74. HIGH TEMPERATURE REACTIONS      \$130,000      01-02  
 A. W. Searcy

Equilibria and kinetics for vaporization and solid-gas reactions at high temperature, decomposition of  $CaCO_3$ , nucleation theory for vapor from condensed phases, rates of vaporization from opposite basal faces of ZnO crystals as a function of temperature, sublimation of Ga fluoride, fragmentation patterns of vapor molecules from  $Al_2Cl_6$ , vaporization of  $BaSO_4$ , mass spectrometry, torsion effusion apparatus.

LAWRENCE BERKELEY LABORATORY  
Inorganic Materials Research Division (Continued)

75. THEORETICAL SOLID STATE PHYSICS                   \$ 25,000    02-02  
       M. L. Cohen

Calculations of the frequency and wavevector dielectric function for Si, charge density calculations for Si Ge Sn GaAs InAs InSb ZnSe CdTe PbTe, transition temperature of superconductors, properties of amorphous semiconductors, relationship between lattice dynamics and superconductivity, electronic structure of high transition temperature superconductors.

76. FAR-INFRARED SPECTROSCOPY                         \$ 85,000    02-02  
       P. L. Richards

Far-infrared spectroscopy in the 2-500/cm range, fourier spectroscopy, lasers, Fabry-Perot interferometer, cryogenic detectors, ac Josephson currents in superconducting tunnel junctions and superfluid He, infrared and phonon generation using non-linear optics techniques, cosmic background radiation.

77. EXPERIMENTAL SOLID-STATE  
       PHYSICS AND QUANTUM ELECTRONICS                 \$125,000    02-02  
       Y. R. Shen

Interaction of light with matter and the optical properties of materials, differential spectrometer to obtain information about the optical excitations of matter, Raman spectrometry, non-linear optical effects, self focusing effect in lasers, far infrared generation by optical beating in magnetic crystals, dispersion of non-linear optical constants for semiconductors.

78. SUPERCONDUCTIVITY, TUNNELING  
       AND CRITICAL PHENOMENA                             \$ 80,000    02-02  
       G. I. Rochlin

Tunneling into Cu Cr V, dilute magnetic alloys of Cu-Cr and Cu-Fe, gapless superconductors, quasiparticle lifetimes in superconductors and excitons in semiconductors using a pulsed laser technique.

## LAWRENCE BERKELEY LABORATORY

Inorganic Materials Research Division (Continued)

79. RESEARCH ON SUPERCONDUCTORS  
AND SUPERCONDUCTING DEVICES \$ 95,000 02-02  
J. Clarke

Technique for predicting superconducting transition temperature of a metal at very low temperature, superconductor-normal-superconductor junction bolometer, asymmetric quantum interferometer to achieve current amplification, dilution refrigerator used to determine superconducting transition temperature in SnTe and AuTe, nonequilibrium effects in superconductors.

## MOUND LABORATORY

Monsanto Research Corporation

P. O. Box 32

Miamisburg, Ohio 45342

L. J. Wittenberg - Phone: Area Code 513 866-7444 x3571

80. LIQUID ACTINIDE METALS RESEARCH \$ 95,000 01-01  
L. J. Wittenberg, C. R. Hudgens

Studies of actinide metals in the solid state near the melting point and in the liquid state, thermal conductivity of Pu Ce La, viscosity of liquid Yb, volume change upon melting, x-ray diffraction study of liquid rare earth and actinide metals Ce Pu, liquid density and viscosity of Th Np, Hall coefficients for liquid Np Pu.

OAK RIDGE NATIONAL LABORATORY  
 P. O. Box X  
 Oak Ridge, Tennessee 37830  
 Phone: Area Code 615 483-8611

Metals and Ceramics Division -01-

J. H. Frye, Jr. - Phone: 483-1554

C. J. McHargue - Phone: 483-1278

81. FUNDAMENTAL CERAMICS \$231,000 01-01  
 G. P. Smith, J. Brynstad,  
 C. R. Boston, C. S. Yust

Dislocation structure by TEM in deformed hyperstoichiometric UO<sub>2</sub> single crystals, deformation behavior and differences between stoichiometric and hyperstoichiometric UO<sub>2</sub>, structure of oxide films formed on U alloys, thermodynamic properties of liquid UO<sub>2</sub>, characterization of phase and structural relationships in B<sub>4</sub>C, effect of electron-phonon coupling on optical transitions in ceramic crystals.

82. PHYSICAL PROPERTY RESEARCH \$186,000 01-01  
 D. L. McElroy, T. G. Kollie,  
 R. K. Williams, J. P. Moore

Physical property data on solids from 1.2 to 2600 K, thermal conductivity, electrical resistivity, thermopower, specific heat capacity, thermal expansion, total hemispherical emittance, refractory metals and alloys (W, Mo, Cr, V, Nb, Ta, Re), lattice heat transport analysis in RbCl RbBr and RbI, development of equipment and computer operated data acquisition system, thermal conductivity of crushed NaCl, graphite and neutron irradiated W, heat transport at low temperatures in UO<sub>2</sub>.

83. METALLURGY OF SUPERCONDUCTING MATERIALS \$186,000 01-01  
 C. C. Koch, D. M. Kroeger

Physical metallurgy of superconducting materials, phase diagrams reaction kinetics and morphologies in Nb and Tc base alloys, properties above 1.2°K and below magnetic fields of 70 kG, ac and dc magnetization measurements, low temperature specific heat capacities, analysis of J<sub>c</sub> measurements, correlation of precipitation and superconductivity in Nb-40% Zr, effect of O on superconducting properties of Nb, ThO<sub>2</sub> dispersions in Nb, test of theoretical models for flux pinning.



OAK RIDGE NATIONAL LABORATORY  
Metals and Ceramics Division -01- (Continued)

84. DEFORMATION OF CRYSTALLINE SOLIDS                    \$116,000      01-01  
    R. O. Williams, R. W. Carpenter,  
    M. H. Yoo

Precipitation studies, thermodynamics, computer simulation of solid solutions, dislocation interactions, precipitation and fractography in Nb-Hf and Nb-Zr alloys, interactions between point defects and dislocations in BCC metals, elastic interaction between interstitial O and glide dislocations in UO<sub>2</sub>, long range ordered structures in FCC lattices.

85. FUNDAMENTAL PHYSICAL METALLURGY                    \$116,000      01-01  
    R. A. Vandermeer, W. A. Coghlan,  
    A. Wolfenden, K. Farrell

Rolling texture in Cu<sub>3</sub>Au, grain size dependence of the hardness of polycrystalline alpha brass and alpha Fe, recrystallization in Al doped with Au, computer simulation study of Auger electron spectra, computer program for calculating binary equilibrium phase diagrams, phase transformations in U alloys, rolling and recrystallization of Ta single crystals, theory of void growth.

86. SURFACE PHENOMENA                                        \$186,000      01-01  
    J. V. Cathcart, R. E. Pawel

Oxidation mechanisms in U based and Ta based alloys, stress generation associated with anion diffusion, stress relief as a result of plastic flow in both oxide and metal, vacancy diffusion as a stress relief process, oxygen solution effects, grain boundary embrittlement, low temperature diffusion of Hf in alloys.

87. CRYSTAL PHYSICS    \$160,000      01-01  
    G. W. Clark, C. B. Finch,  
    J. C. Wilson

Directional solidification of eutectic systems, single crystal preparation, UO<sub>2</sub>-W system, UO<sub>2</sub>-W-MgO ternary eutectic, hydrothermal growth of PbS crystals, quartz, structure of Rb iron feldspar, single crystals of PuO<sub>2</sub>, transuranium doped CeO<sub>2</sub> crystals, ThO<sub>2</sub>, transuranium doped RbCaF<sub>3</sub>.

## OAK RIDGE NATIONAL LABORATORY

Metals and Ceramics Division -01- (Continued)

88. FUNDAMENTAL RESEARCH IN  
X-RAY DIFFRACTION \$139,000 01-02  
B. S. Borie, R. W. Hendricks,  
C. J. Sparks, H. L. Yakel

Small angle x-ray scattering studies of irradiated Al and B<sub>4</sub>C, characterization of B<sub>4</sub>C, x-ray diffraction studies of metastable U alloys, diffuse x-ray scattering in Nb-V system, local structure in Ta-Nb alloys, diffuse x-ray scattering in CaF<sub>2</sub>-YF<sub>3</sub>.

89. THEORETICAL RESEARCH \$139,000 01-02  
J. S. Faulkner, G. S. Painter,  
G. M. Stocks

Fundamental studies of electronic states in solids, theory of disordered systems, dielectric constants and optical properties in diamond, density of states and Fermi surface of Cs under pressure, calculations in the Ag-Pd system, phase stability, defect production and diffusion.

90. DIFFUSION IN SOLIDS \$186,000 01-02  
P. T. Carlson, R. A. Perkins

Anisotropic diffusion in ceramics, effects of varying stoichiometry and vacancy concentration on diffusion in ceramics, grain boundary and short circuit diffusion mechanisms, thermomigration in ionic and ceramic materials, effects of high pressure, TiO<sub>2</sub>, tracer diffusion in Fe-Cr-Ni system, thermal diffusion of Cd and Tl in NaCl and KCl, diffusion of Hf in Ta-W-Hf alloys, diffusion at high pressure in Nb Ta and W, diffusion of T and D in refractory metals.

91. RADIATION DAMAGE \$300,000 01-03  
K. Farrell, A. Wolfenden,  
M. H. Yoo, J. O. Stiegler,  
B. T. M. Loh, H. L. Yakel

Systematic study of elevated temperature radiation damage on zone refined Al, effect of coherent and noncoherent precipitates in Al-Cu alloys, Al-<sup>6</sup>Li alloys, in situ radiation damage using HVEM, theoretical studies of dislocation loop nucleation, comparison of ion bombardment with neutron and electron irradiation in Al Ni and V, TEM of irradiated B<sub>4</sub>C, thermodynamic properties of He in vacancy-helium clusters, neutron small angle scattering of irradiated Al and vitreous SiO<sub>2</sub>.

## OAK RIDGE NATIONAL LABORATORY

Solid State Division -02-

M. K. Wilkinson - Phone: 483-6713

92. RESEARCH AND DEVELOPMENT

## ON PURE MATERIALS

\$664,000 02-01

J. W. Cleland, G. W. Clark,  
 J. C. Wilson, C. B. Finch,  
 T. F. Connolly, C. T. Butler,  
 R. E. Reed, C. C. Robinson,  
 W. E. Brundage, R. D. Westbrook,  
 F. J. Bruni

Purification, crystal growth, characterization and analysis of research materials, Research Materials Information Center, carbon-arc-fusion technique for high purity single crystals of MgO CaO and SrO, Ge radiation detector crystals, Y-Tb and Y-Ho crystals for neutron diffraction, EuO, electron beam floating zone technique for Nb-Mo Nb-Zr and Nb-V crystals, large ferrite crystals for neutron beam switching, HgI<sub>2</sub> crystals, high purity V and other refractory metals.

93. SUPERCONDUCTIVITY

\$109,000 02-02

S. T. Sekula, R. H. Kernohan,  
 S. W. Schwenlerly

Bulk magnetization measurements of superconductivity in V, effect of neutron irradiation on V, ac losses in Nb-Ti, fast neutron damage in Nb-Mo, effect of irradiation on Type I superconductors.

94. NEUTRON SPECTROMETRY

\$400,000 02-02

H. G. Smith, H. A. Mook,  
 R. M. Nicklow, N. Wakabayashi

Inelastic neutron scattering from magnetic and non-magnetic materials, critical scattering near chemical and magnetic phase transitions, polarized neutron scattering, small angle scattering, phonon dispersion curves of HCP Sc Y Zr Co and Ti, neutron coherent inelastic scattering from pyrolytic graphite, phonon dispersion curves in Mg<sub>2</sub>Pb UC TaC HfC NbC VC ZrC MnF<sub>2</sub> MoS<sub>2</sub> NbSe<sub>2</sub> CaWO<sub>4</sub>, neutron inelastic scattering in superfluid <sup>4</sup>He, magnon energy spectrum in Dy, crystal field splittings in TmN TmBi, critical neutron scattering from Gd, crystal field excitations in Sm, magnetic excitations in Y-Tb alloys, atomic motion in amorphous solids.

OAK RIDGE NATIONAL LABORATORY  
Solid State Division -02- (Continued)

95. SPIN RESONANCE \$ 80,000 02-02  
 M. M. Abraham, J. L. Kolopus

ESR to study the details of the local environment around a paramagnetic impurity or radiation induced defect in diamagnetic insulating crystals, MgO CaO SrO, effect of Li and Na dopants, zero field splitting of the transuranic S-state ions Am<sup>2+</sup> and Cm<sup>3+</sup> in fluorite-type crystals, zircon-structure silicates doped with Tb.

96. NEUTRON DIFFRACTION \$400,000 02-02  
 W. C. Koehler, J. W. Cable,  
 H. R. Child, R. M. Moon,

Form factors and magnetic moment distributions in metals and alloys (FeNi, FeNi<sub>3</sub>, FeAu<sub>3</sub>), magnetic moment distribution around Fe impurities in Ni<sub>3</sub>Ga, magnetic structure of Sm CeBi Pm V<sub>2</sub>O<sub>5</sub>, magnetic scattering effects associated with the Kondo state in CeAl<sub>2</sub> CeAl<sub>3</sub>, form factor of Gd, effect of applied field on spin wave spectrum in <sup>160</sup>Gd, spin wave spectrum of Tm.

97. DEFECT STRUCTURES IN NONMETALS \$326,000 02-02  
 E. Sonder, Y. Chen,  
 J. C. Pigg, L. C. Templeton,  
 O. E. Schow, F. A. Modine

Optical absorption and ESR in MgO CaO and SrO, radiation defects in BeO, F-center production at and above room temperature in pure doped and deformed LiF, stored energy due to radiation in NaCl, radiation defect production in alkaline earth oxides, radiation effects in Be<sub>2</sub>LiF<sub>4</sub>.

98. ION BOMBARDMENT \$ 90,000 02-02  
 B. R. Appleton

Channeling behavior of high energy heavy ions, 2.5 MV positive ion accelerator, energy loss for I ions transmitted through thin crystals of Ag, radiation damage caused by MeV electrons in ZnO, hyperchanneling and planar channeling.

OAK RIDGE NATIONAL LABORATORY  
Solid State Division -02- (Continued)

99. X-RAY DIFFRACTION AND  
 ELECTRON MICROSCOPY \$210,000 02-03  
 T. S. Noggle, S. M. Ohr,  
 J. M. Williams, B. C. Larson,  
 F. A. Sherrill

Fast neutron damage in nearly perfect Cu crystals, anomalous x-ray transmission, diffuse scattering, Bragg reflection line widths and transmission electron microscopy, Lang topography of nickel ferrite crystals, strain fields due to precipitates in Cu-Co alloys, in-situ radiation damage in graphite using electrons in TEM, single crystal films, theory of the interaction of electrons and x-rays with defects in solids.

100. THEORY AND COMPUTATIONS \$441,000 02-03  
 D. K. Holmes, R. F. Wood,  
 M. T. Robinson, J. H. Barrett,  
 J. F. Cooke, H. L. Davis,  
 B. N. Ganguly, M. E. Mostoller,  
 O. S. Oen

Radiation damage, lattice dynamics, magnetism, electronic structure of solids, low loss heavy channeled ions (hyperchanneling), Monte Carlo channeling calculations, calculations of the deposition of atomic recoil energy in solids by MeV ions, cross sections for displacing atoms in solids by fast electrons, influence of chromatic aberration on visibility of defect clusters in TEM, computer simulation of radiation damage, point defects, magnetic neutron scattering in itinerant ferromagnets, spin waves in rare earths, magnetic form factors for Gd Sm, band structure for ThSb NpSb AmSb HfC TaC, crystal field splittings in rare-earth compounds, acoustical plasmons phonon anomalies and superconductivity in transition metal systems, applications of the coherent-potential approximation.

101. SURFACE STUDIES ON METALS \$210,000 02-03  
 F. W. Young, Jr., L. H. Jenkins,  
 U. Bertocci, D. M. Zehner

LEED from Si Al Co Sc surfaces, defects in electrodeposited Cu, secondary electron spectra from solids, low energy (less than 1 KeV) sputtering, surface characterization by LEED-Auger analysis.

OAK RIDGE NATIONAL LABORATORY  
Solid State Division -02- (Continued)

102. RADIATION EFFECTS AND  
ANELASTICITY IN METALS \$490,000 02-03  
R. R. Coltman, V. K. Pare,  
H. D. Guberman, C. E. Klabunde,  
A. L. Southern, J. K. Redman

Temperature dependence of thermal neutron damage in Pt, elastic modulus measurements to determine the total number of dislocation pinning points in fast neutron irradiated Cu, anelasticity measurements in liquid helium facility at the BSR, internal friction of helium implanted Nb, fission neutron damage at less than 5°K in Cu Al V Nb, density changes and resistivity measurements on fast neutron irradiated metals.

PACIFIC NORTHWEST LABORATORY  
P. O. Box 999  
Richland, Washington 99352  
Phone: Area Code 509 942-7411

103. TRANSURANIUM PHYSICAL METALLURGY RESEARCH \$277,000 01-01  
R. D. Nelson, S. D. Dahlgren,  
M. D. Merz, R. P. Allen

Phase transformations in Pu, properties of sputter deposited Pu, deformation processes in Pu, physical metallurgy of Np, self irradiation damage in Pu, use of sputtering technique to prepare superconductors.

104. TRANSURANIUM CERAMICS RESEARCH \$ 75,000 01-02  
T. D. Chikalla, R. P. Turcotte

Solid state properties and thermodynamic behavior of trans-uranium ceramic materials, oxygen decomposition pressures over nonstoichiometric Bk and Cm oxides, effect of self-irradiation damage on PuO<sub>2</sub>, oxygen decomposition pressures in the Np oxide system.

105. RADIATION EFFECTS ON METALS \$243,000 01-03  
J. L. Brimhall, H. E. Kissinger,  
E. Simonen

Elevated temperature radiation effects in metals due to neutrons heavy ions or electrons, yield strength, ductility, bulk density, lattice parameter, electrical resistance, transmission electron microscopy, Mo Nb Ni Re, void lattice, effect of alloying on voids in Cu-Ni, neutron damage in Au, defect structure in Ni, effect of stress on void formation in Ni, theory of void formation.

SECTION B  
Universities

The information was taken from current 200-word summaries provided by the contractor. There is considerable (about 10%) turnover in the University program and some of the projects will not be continued beyond the current contract period.





## ALABAMA A&amp;M UNIVERSITY

201. THEORETICAL INVESTIGATIONS OF THE  
ELECTRONIC STRUCTURE AND PROPERTIES  
OF METALS AND SEMICONDUCTORS \$ 25,000 02-02  
H. J. Foster - Dept. of Physics (18 mos. thru  
and Mathematics 11/30/72)

Theoretical studies of Fermi surface, impurity contributions, energy gap anisotropy, density of states, electron-impurity scattering cross sections, K.

## ARIZONA, UNIVERSITY OF

202. IMPURITY DIFFUSION IN SOLIDS \$ 86,400 02-02  
C. T. Tomizuka - Dept. of Physics

Application of high pressure and radioactive tracers to the study of diffusion-controlled phenomena in solids, solid He, Zn, solid H<sub>2</sub>O.

## BROWN UNIVERSITY

203. A COMBINED MACROSCOPIC AND MICRO-  
SCOPIC APPROACH TO THE FRACTURE  
OF METALS \$ 81,900 01-01  
J. Gurland - Division of Engineering

Influence of microstructure on fracture modes, fracture strength of steels, theory of ductile fracture, dynamic fracture toughness, stress intensity factor at very high crack speeds.

## CALIFORNIA INSTITUTE OF TECHNOLOGY

204. STUDIES OF ALLOY STRUCTURES  
AND PROPERTIES \$220,000 01-02  
P. Duwez and C. C. Tsuei - Division  
of Engineering and Applied Science

Structure and physical properties of non-equilibrium alloys obtained by rapid quenching from the liquid state, amorphous alloys, x-ray diffraction, electron diffraction and microscopy, superconductivity, ferromagnetism, electrical resistivity, specific heat, Mössbauer effect, NMR, kinetics of amorphous to crystalline transformation, semiconductor materials.

## CALIFORNIA INSTITUTE OF TECHNOLOGY (Continued)

205. DISLOCATION MOBILITY AND DENSITY  
IN METALLIC CRYSTALS \$ 67,457 01-01  
T. Vreeland, Jr. - Division of  
Engineering and Applied Science

Transmission electron microscopy and diffraction to study crystal defects, weak beam microscopy and atomic resolution obtained by computer image enhancement of Fourier images, effect of neutron irradiation on dislocation mobility in Zn, dislocation velocity in Cu, normal and superconducting Pb, theoretical studies of dislocation-phonon and -electron interactions, effect of magnetic field on electron mean free path.

## CALIFORNIA, UNIVERSITY OF

206. PARTICLE SIZE DISTRIBUTION EFFECTS  
IN PRECIPITATION HARDENING \$ 54,000 01-01  
A. J. Ardell - Materials Dept.,  
Los Angeles

Effect of precipitate size distributions on mechanical behavior of Ni-base  $\gamma/\gamma'$  alloys, kinetics of precipitation, Ni-Al, Ni-Cr-Al, transmission electron microscopy and Curie temperature measurements, void formation in proton irradiated  $\gamma/\gamma'$  alloys, effect of precipitates on resistance to swelling, theoretical studies on coarsening of precipitates.

207. FOURIER SPACE COMPUTER SIMULATION  
OF CRYSTALLINE IMPERFECTIONS \$ 28,680 01-02  
D. de Fontaine - Materials Dept.,  
Los Angeles

Application of Fourier space transform technique to direct computer simulation of crystal defects, solute segregation, precipitation, dislocation-atom cluster interactions, correlated displacement effects.

208. ELECTRIC AND MAGNETIC PROPERTIES OF  
TRANSITION METALS AND THEIR COMPOUNDS \$ 65,500 02-02  
A. W. Lawson - Dept. of Physics,  
Riverside

Magnetic susceptibility in EuSe EuTe  $\text{Sm}_2\text{Te}_3$ , AFMR in EuTe  $\text{CrCl}_3$ , magnetic anisotropy in GdN EuS, ferromagnetic resonance in DySb.

## CALIFORNIA, UNIVERSITY OF (Continued)

209. NEW MATERIALS BY LOW TEMPERATURE  
CONDENSATION \$141,000 01-01  
(18 mos.)  
Huey-Lin Luo - Dept. of Applied  
Physics and Information Science,  
San Diego

Sputtering method used to deposit new materials, superconducting materials Nb-Al-Ge, magnetic materials ZrZn<sub>2</sub>, metastable phases.

210. RESEARCH ON THE PROPERTIES OF  
MATERIALS AT VERY LOW TEMPERATURES \$147,179 02-02  
J. C. Wheatley - Dept. of Physics,  
San Diego

Bulk polarization of solid <sup>3</sup>He nuclei, spin diffusion relaxation entropy of solid-liquid mixtures, thermal coupling between pure liquid <sup>3</sup>He and magnetic solids such as CMN and alloys of Fe in Pt and Pd, spin diffusion and nuclear susceptibility of pure <sup>3</sup>He cooled by a magnetic surface coupling with an adiabatically demagnetized metal, low temperature thermometry via thermal fluctuations of current in a resistive-inductive circuit coupled to a superconducting device.

## CARNEGIE-MELLON UNIVERSITY

211. OPTICAL AND MICROWAVE SPECTROSCOPY  
OF Np AND Co IN SCHEELITES AND  
OTHER CRYSTALLINE ENVIRONMENTS \$ 20,831 02-02  
J. O. Artman - Depts. of Physics  
and Electrical Engineering

Charge compensation and conversion mechanisms in Np-CaF<sub>2</sub> specimens, EPR, optical Zeeman studies, energy level calculations.

## CASE WESTERN RESERVE UNIVERSITY

212. MOTION OF IONS IN SOLID HELIUM \$ 31,710 02-02  
A. J. Dahm - Dept. of Physics

Mechanisms of ion mobility in solid helium, positive ion and negative ion mobilities as a function of temperature and density, EPR of electrons trapped in voids, lifetime measurements of ortho-positronium, extraction of negative ions from the liquid through the liquid-vapor interface.

## CASE WESTERN RESERVE UNIVERSITY (Continued)

213. DISLOCATION-SOLUTE ATOM INTERACTIONS IN ALLOYS \$ 40,000 01-01  
R. Gibala - Div. of Metallurgy and Materials Science

Strengthening mechanisms in alloys, internal friction, mechanical properties, electron microscopy, nature of solute obstacles to dislocation motion, magnitude of dislocation-obstacle interaction energies, strain aging, interstitial-defect interaction in austenitic steels, dislocation-solute atom interaction in Nb and Nb alloys, interstitial and substitutional solute hardening in Nb, anelasticity of BCC solid solutions.

214. SOLID STATE PHYSICS \$ 83,000 02-02  
R. W. Hoffman - Dept. of Physics

Mössbauer spectra of thin films, Ni, pressure and temperature variation of dielectric constant in alkali halides and alkaline earth fluorides, effects of impurities on dielectric constant, theoretical studies of spin waves in amorphous ferromagnets, calculations of transport properties of anisotropic metals.

215. EXPERIMENTS IN HIGH VOLTAGE ELECTRON MICROSCOPY \$ 54,000 01-03  
T. E. Mitchell - Div. of Metallurgy and Materials Science

High voltage (650 kV) electron microscopy, selected area diffraction of small particles in alloys and glass, in-situ electron radiation damage of Al, Cu, stainless steel and  $\text{CaF}_2$ .

## CHICAGO, UNIVERSITY OF

216. THE STUDY OF PHONONS IN AMORPHOUS AND CRYSTALLINE SOLIDS \$ 39,000 02-02  
S. A. Solin - Dept. of Physics

Optic phonon damping processes,  $\text{RbClO}_3$ , spontaneous and resonance raman effect in amorphous solids, phonon bound states and resonances, YAG laser,  $\text{CO}_2$  laser, amorphous  $\text{As}_2\text{S}_3$ , Ge, Si.

## CINCINNATI, UNIVERSITY OF

217. RADIATION EFFECTS ON BCC REFRACTORY METALS AND ALLOYS \$ 45,000 01-03  
 J. Moteff - Dept. of Materials Science and Metallurgical Eng.

Nature and number of defect clusters produced by high temperature neutron irradiation, transmission electron microscopy, resistivity, hardness, annealing kinetics, void volume, lattice parameters, Nb, Nb-1Zr, Mo, Mo-.5Ti, W, W-25Re.

## CLARK UNIVERSITY

218. EXPERIMENTAL STUDIES OF CRITICAL POINT BEHAVIOR IN MAGNETICALLY ORDERED SOLIDS USING NUCLEAR GAMMA-RAY SPECTROSCOPY, AND RELATED EXPERIMENTS \$ 27,213 02-02  
 C. Hohenemser - Dept. of Physics

Time dependent perturbed angular correlation studies in ferromagnetic Ni, static and dynamical critical phenomena, hyperfine field and angular correlation relaxation measurements.

## CLARKSON COLLEGE OF TECHNOLOGY

219. TRANSPORT AND MAGNETIC PHENOMENA IN CHROMIUM AND IRON ALLOYS \$ 25,141 02-02  
 S. Arajs - Dept. of Physics

Electrical resistivity, thermoelectric power, magnetization, thermal conductivity, Cr base alloys, Fe base alloys, measurements up to 1500°K.

220. NUCLEATION OF VOIDS \$ 19,687 01-03  
 J. L. Katz - Dept. of Chemical Engineering

Theoretical studies of the rates of homogeneous nucleation of voids, effects of insoluble gases and strain.

## COLORADO, UNIVERSITY OF

221. CRITICAL SCATTERING OF LASER LIGHT  
 BY THIN FLUID FILMS \$ 38,675 02-02  
 R. Mockler and W. O'Sullivan - Dept.  
 of Physics and Astrophysics

Fluid films constrained by rigid walls to a thickness on the order of the wavelength of visible light, to determine critical behavior of these "2-dimensional" films very near the phase transition, Xe films, laser light scattering, methods of internal reflection spectroscopy and close spaced Fabry-Perot interferometry.

## CORNELL UNIVERSITY

222. DEFECTS IN METAL CRYSTALS \$185,000 01-03  
 R. W. Balluffi and D. N. Seidman -  
 Dept. of Materials Science  
 and Engineering

Point defects, line defects, planar defects, direct observation of defects using FIM, observations of self-ion irradiated metal crystals, Pt W Au, application of atom probe FIM to point defect studies, electrical resistivity, transmission electron microscopy, quenched specimens, computer simulation of contrast effects produced by defects in FIM specimens, structure of grain boundaries, grain boundary dislocation climb.

223. STUDIES OF LOW TEMPERATURE PHASE  
 TRANSFORMATIONS IN HIGH FIELD SUPER-  
 CONDUCTORS AND THE PHONON SPECTRUM  
 AND MECHANICAL PROPERTIES OF VANADIUM \$ 22,989 01-02  
 B. W. Batterman - Dept. of Materials  
 Science and Engineering

Structural transformation in Nb<sub>3</sub>Sn and V<sub>3</sub>Si, thermal diffuse scattering of x-rays to obtain information on the change in phonon spectrum in the vicinity of the transformation, phonon dispersion of V, precipitation of H in V.

## CORNELL UNIVERSITY (Continued)

224. EFFECT OF ENVIRONMENT ON  
FRACTURE BEHAVIOR \$ 32,872 01-01  
H. H. Johnson - Dept. of Materials  
Science and Engineering

Hydrogen brittleness, hydrogen "trapping" in Fe and steel at 300°K, permeation technique to evaluate solubility and diffusivity of lattice and trapped hydrogen, Nb, V, effect of plastic deformation and annealing.

225. A STUDY OF THE INTERACTION BETWEEN  
MAGNETIC FLUXOIDS AND CRYSTAL  
DEFECTS IN TYPE II SUPERCONDUCTORS \$ 37,609 01-02  
E. J. Kramer - Dept. of Materials  
Science and Engineering

Surface pinning of fluxoids in Nb single crystals, effects of dislocation density and magnetic field strength, effect of neutron irradiation, theory of surface fluxoid pinning.

226. THEORETICAL PHONON PHYSICS \$ 61,250 02-02  
J. A. Krumhansl - Dept. of Physics,  
Laboratory of Atomic and  
Solid State Physics

Theory of quantum and classical lattice excitations in condensed matter, electrical thermal and optical properties, anharmonic solids, excitations in disordered systems, transport involving phonons, computer studies of liquids, soft modes, high density behavior.

227. GRAIN BOUNDARY SLIDING AND STRUCTURE \$ 35,000 01-01  
Che-Yu Li - Dept. of Materials  
Science and Engineering

Mechanical behavior of polycrystalline solids at elevated temperature, grain boundary sliding as a function of stress temperature and structure, grain boundary structural transition at elevated temperatures.



## CORNELL UNIVERSITY (Continued)

228. EXPERIMENTAL PHONON PHYSICS \$135,540 02-02  
 R. O. Pohl and A. J. Sievers - Dept.  
 of Physics, Laboratory of Atomic  
 and Solid State Physics

Lattice dynamics of non-crystalline solids, disordered systems, low temperature thermal conductivity, heat pulse propagation, specific heat, far infrared absorption, dielectric constant, second sound in solids, effect of pressure and magnetic field, NaF Cu-Fe Pb In-Pb Bi.

229. ELASTIC AND PLASTIC DEFORMATION OF SOLIDS \$120,000 01-01  
 A. L. Ruoff - Dept. of Materials  
 Science and Engineering

Equation of state and the pressure dependence of the Gruneisen parameter, Si Na NaCl, elastic behavior of Na near the phase transformation, creep deformation, hydrostatic extrusion.

230. SOLID STATE PHYSICS: MAGNETIC PHENOMENA \$130,885 02-02  
 R. H. Silsbee and R. Bowers - Dept.  
 of Physics, Laboratory of Atomic  
 and Solid State Physics

Microwave resonance in molecular and off-center defects in insulating materials, quantum tunneling, transport properties in metals, thermal and magnetothermal conductivity measurements, umklapp and other phonon scattering processes in K, Hall coefficient in K, high frequency helicon magnetoplasma waves and ultrasonic waves, radio frequency surface impedance techniques.

## DARTMOUTH COLLEGE

231. MEASUREMENT OF ELECTRON ENERGY BAND STRUCTURE IN CONDUCTORS \$ 28,041 02-02  
 J. R. Merrill - Dept. of Physics  
 and Astronomy

Radio frequency studies of the propagation of helicon plasma waves in metals, propagation of helicon-like waves in superconductors, studies of energy gap anisotropy in superconductors, plasmon wave effects by means of electron tunneling.

## FLORIDA, UNIVERSITY OF

232. QUANTITATIVE ANALYSIS OF SOLUTE SEGREGATION IN ALLOYS BY TRANSMISSION ELECTRON MICROSCOPY \$ 36,000 01-02  
 J. J. Hren and C. S. Hartley -  
 Dept. of Metallurgical and  
 Materials Engineering

Computer simulation methods to extract quantitative data from transmission electron microscope images, precipitation on crystalline defects, changes in image topography and contrast, nucleation of precipitates in binary alloys, Al-Cu, Al-Ag, Al-Mg, Cu-Al.

233. DEFORMATION PROCESSES IN HEXAGONAL METALS \$ 31,150 01-01  
 R. E. Reed-Hill - Dept. of  
 Metallurgical and Materials Eng.

Effects of dynamic strain aging and deformation twinning on yielding, work hardening, Ti, Zr, strain-rate dependent work hardening phenomena, dynamic recovery, optical and electron microscopy, dislocation dynamics, effects of interstitial atom impurities on strain aging.

## GEORGETOWN UNIVERSITY

234. THE STUDY OF VERY PURE METALS AT LOW TEMPERATURES \$ 39,000 02-02  
 W. D. Gregory - Dept. of Physics

Studies of superconducting metals using bulk tunneling, Ga, Al, In, Fermi surface calculations, measurements of shift in  $T_c$  on crystal orientation, properties of In-Ga alloys, ac susceptibility technique for measuring superconductivity properties.

## GEORGIA INSTITUTE OF TECHNOLOGY

235. A STUDY OF THE STRUCTURE AND MECHANICAL PROPERTIES OF ORDERED ALLOYS \$ 37,000 01-01  
 B. G. LeFevre and E. A. Starke, Jr. -  
 School of Chemical Engineering

Long range order, domain size, internal strains, internal friction, deformation modes, correlation of microstructure and order parameters with mechanical properties,  $Ni_4Mo$ , CuPt.

## HAWAII, UNIVERSITY OF

236. PHOTOELECTRIC EMISSION FROM THIN FILMS  
IN THE VACUUM ULTRAVIOLET REGION \$ 25,025 02-02  
W. Pong - Dept. of Physics and  
Astronomy

Photoelectric properties of thin films in the photon energy range 7-23 eV, electron attenuation lengths, electron-electron scattering lengths, amorphous Se, Cu phthalocyanine, photo-emission from Nb<sub>2</sub>O<sub>5</sub>, PbTe, Al<sub>2</sub>O<sub>3</sub>, Ta<sub>2</sub>O<sub>5</sub>, exciton effects in alkali halides.

## HOWARD UNIVERSITY

237. RADIATION DAMAGE IN OPTICALLY  
TRANSPARENT MATERIALS (ZIRCONS) \$ 20,000 02-03  
A. N. Thorpe - Dept. of Physics

Radiation effects on ZrSiO<sub>4</sub>, infrared spectroscopy, magnetic properties, effects of natural alpha decay, neutron irradiation, fission products, magnetic susceptibility at low temperature.

## ILLINOIS INSTITUTE OF TECHNOLOGY

238. THE STRENGTHENING AND TOUGHENING  
OF BRITTLE MATERIALS \$ 34,000 01-01  
L. J. Broutman - Dept. of Metal-  
lurgical and Materials Engineering

Effect of spherical and fibrous particles on the strength and toughness of brittle materials, strength determinations, fracture toughness measurements as a function of fiber volume fraction, interface treatment and length to diameter ratio, glass fibers in KTiO<sub>4</sub> single crystals.

239. THERMAL MEASUREMENTS ON  
SOLIDS BELOW 1°K \$ 93,000 02-02  
H. Weinstock - Dept. of Physics

Low temperature thermal conductivity and specific heat measurements to study defects produced by neutron irradiation on MgO and pyrolytic graphite, heavy ion damage to amorphous carbon, thermal conductivity of superconducting materials, Al-Pb-Al thin film sandwich, La-Gd-In, Va<sub>3</sub>Ga, Nb<sub>3</sub>Sn, Kondo alloys of Cu, effects of magnetic ordering in antiferromagnetic insulators.

## JOHNS HOPKINS UNIVERSITY

240. ACOUSTIC EMISSION AND THE PORTEVIN-LE  
CHATELIER EFFECT \$ 27,025 01-01  
W. F. Hartman and J. F. Bell -  
Dept. of Mechanics

Strain hardening of alloys, emissions associated with discontinuous yielding will be monitored for various strain rates and temperatures, to achieve a better understanding of the sources of acoustic emission.

## LEHIGH UNIVERSITY

241. FORMING OF COMPOSITE MATERIALS \$ 34,000 01-01  
B. Avitzur - Dept. of Metallurgy  
and Materials Science

Multifilament Nb-44% Ti superconductor in an Al matrix, extrusion processing.

## MARQUETTE UNIVERSITY

242. DEFECT STRUCTURES IN NONSTOICHIOMETRIC OXIDES \$ 34,186 01-02  
R. N. Blumenthal - Dept. of  
Mechanical Engineering

Thermodynamic and electrical property investigation of  $Ce_{1+y}O_2$  and CaO-doped  $CeO_2$ , electrical conductivity, Hall mobility, ionic transference and thermogravimetric weight measurements as a function of oxygen partial pressure, composition and temperature, defect structure and diffusion coefficients.

## MARYLAND, UNIVERSITY OF

243. AN INVESTIGATION OF IRRADIATION  
STRENGTHENING OF BCC METALS AND  
SOLID SOLUTIONS \$ 43,000 01-03  
R. J. Arsenault - Dept. of  
Chemical Engineering

Effect of neutron irradiation on the rate controlling mechanism of low temperature plastic deformation in BCC metals, activation parameters for deformation, dislocation dynamics, V, Mo.

## MARYLAND, UNIVERSITY OF (Continued)

244. ALLOY STRENGTHENING DUE  
TO ATOMIC ORDER \$ 35,000 01-02  
M. J. Marcinkowski - Dept. of  
Mechanical Engineering

Deformation behavior of ordered alloys, transmission electron microscopy, computer modeling of work hardening, studies of crack initiation and propagation in the scanning electron microscope, temperature dependence of order strengthening, neutron scattering.

245. THE GALVANOMAGNETIC PROPERTIES  
OF GRAPHITE IN THE TEMPERATURE  
RANGE 4-300°K AND PRESSURE  
RANGE 0-10,000 BARS \$ 31,203 01-01  
I. L. Spain - Dept. of Chemical  
Engineering

Hall and magnetoresistance coefficients of graphite crystals from 0 to 10,000 kg/cm<sup>2</sup>, temperature range 4-300°K, synthetic and natural crystals, changes in electronic properties of graphite due to grain boundaries, dislocations and radiation-induced acceptors.

## MASSACHUSETTS INSTITUTE OF TECHNOLOGY

246. THERMAL NEUTRON SCATTERING  
STUDIES OF MOLECULAR DYNAMICS  
AND CRITICAL PHENOMENA IN  
FLUIDS AND SOLIDS \$ 95,000 02-02  
S. H. Chen and S. Yip - Dept. of  
Nuclear Engineering

Automated 3-axis neutron spectrometer used for inelastic neutron scattering studies, neutron transmission and scattering measurements on one- and two-component systems near their phase transition point, Li-Na, Ga-Bi, Al-Zn, Xe, Xe-He, collision narrowing of quasi-elastic peak in H gas under pressure, concentration and temperature dependence of long wavelength phonons in alkali halide mixed crystals.

## MASSACHUSETTS INSTITUTE OF TECHNOLOGY (Continued)

247. BASIC RESEARCH IN CRYSTALLINE AND  
NONCRYSTALLINE CERAMIC SYSTEMS . \$288,000 01-01  
W. D. Kingery and R. L. Coble -  
Dept. of Metallurgy and Materials  
Science

Diffusion in polycrystal  $Al_2O_3$ , defect structure in single crystal  $Al_2O_3$ , cation diffusion in single crystal ZnO, sintering of  $Cr_2O_3$ , effect of thermal gradient on polycrystalline sintered  $UO_2$ , thermal gradient studies in  $(U,Ce)O_2$ , chemical vapor deposition of  $UO_2$ , MgO and MgO- $Al_2O_3$  single crystals, tunneling in amorphous Si, thermal neutron irradiation of amorphous Si films, conduction mechanism in  $Al_2O_3$ , strain centers in sapphire, x-ray topography of oxides, dislocation behavior in pure and Fe-doped single crystals of MgO, grain boundary sliding in  $Al_2O_3$  and MgO, optical and electrical properties of single crystal  $Fe_xO$ -MnO solid solutions, low temperature conductivity and reflectivity of chemical vapor-deposited FeO.

248. LOW TEMPERATURE AND  
NEUTRON PHYSICS STUDIES \$119,960 02-02  
C. G. Shull - Dept. of Physics

Polarized neutron scattering studies on crystals of Bi magnetized in a high superconducting magnetic field, to understand the source of anomalous diamagnetism of Bi, nuclear polarization in H-containing crystals.

## MASSACHUSETTS, UNIVERSITY OF

249. ULTRASONIC ATTENUATION STUDIES OF  
THE ELECTRONIC STRUCTURE OF METALS \$ 40,373 02-02  
A. R. Hoffman - Dept. of Physics  
and Astronomy

Low temperature thermal conductivity of pure single crystal Be, relationships between waveforms of quantum oscillations associated with equilibrium and transport measurements, propagation of sound in the mixed state of a type-II superconductor (Nb), acoustic NMR in bulk metals, dynamic interaction of sound waves with conduction electrons near  $T_c$  in type-I superconductors.

## MICHIGAN STATE UNIVERSITY

250. PROPERTIES OF RARE-GAS SOLIDS \$ 37,165 02-02  
G. L. Pollack - Dept. of Physics

Thermodynamic and surface properties of rare gas solids and other molecular solids, thermal conductivity of A, vapor and sublimation pressures of NH<sub>3</sub> N<sub>2</sub> O<sub>2</sub> H<sub>2</sub> Cl<sub>2</sub> F<sub>2</sub>, superfluid He flow rates in solid A, theoretical study of Kapitza resistance, law of corresponding states.

## MICHIGAN TECHNOLOGICAL UNIVERSITY

251. STRUCTURE AND PROPERTIES OF SOLID SOLUTIONS \$ 42,000 01-01  
A. A. Hendrickson and D. A. Koss -  
Dept. of Metallurgical Engineering

Interaction between substitutional solute atoms and mobile dislocations, serrated yielding in FCC Ag base alloys, compositional dependence of yield stress in BCC alloy single crystals.

252. EFFECT OF ANNEALING ON THE SUBSTRUCTURE OF COLD WORKED FCC METALS AND ALLOYS \$ 31,000 01-02  
D. E. Mikkola - Dept. of  
Metallurgical Engineering

Substructure changes in annealed cold worked FCC metals and alloys, x-ray diffraction, transmission electron microscopy, single-layer and multilayer stacking fault annealing behavior in Cu-base solid solution alloys, kinetics and mechanisms of ordering in alloys.

253. A STUDY OF GRAIN BOUNDARY SEGREGATION USING THE AUGER ELECTRON EMISSION TECHNIQUE \$ 47,556 01-01  
D. F. Stein - Dept. of Metallurgical Engineering

Studies of segregation of minute amounts of impurities to grain boundaries and other interfaces, fracture properties of alloys, intergranular corrosion, stress corrosion cracking, high temperature brittleness, stainless steel, Al<sub>2</sub>O<sub>3</sub>.

## MINNESOTA, UNIVERSITY OF

254. ANALYSIS OF THE DUCTILE-BRITTLE  
TRANSITION TEMPERATURE IN Fe-  
BINARY ALLOYS \$ 32,000 01-01  
W. W. Gerberich - Dept. of Chemical  
Engineering and Materials Science

Flow and fracture characteristics of binary alloys of Fe, effect of atomic size on ductile-brittle transition temperature, dislocation dynamics applied to flow and fracture, acoustic emission technique to analyze the number of non-propagating cleavage microcracks.

255. EXPERIMENTAL AND THEORETICAL  
STUDIES IN SOLID STATE AND  
LOW TEMPERATURE PHYSICS \$179,913 02-02  
A. M. Goldman, L. H. Nosanow,  
W. Weyhmann, W. Zimmerman, Jr. -  
Dept. of Physics

Superconductivity, experimental and theoretical studies of quantum crystals, magnetism, liquid He, pair-field susceptibility of superconductors, the effects of fluctuations on the Josephson current, exchange in solid  $^3\text{He}$ , theory of solid mixtures of  $^3\text{He}$  and  $^4\text{He}$ , dense nuclear matter, heat capacity of solid  $^3\text{He}$  below  $1^\circ\text{K}$ , spin reorientation transition, nuclear orientation experiments on the Kondo effect of very dilute rare earth and Fe impurities in alloys, enhanced nuclear hyperfine cooling, quantized circulation in superfluid He, superfluid He analog of the Josephson effect.

256. "IN-SITU" ELECTRON MICROSCOPE  
INVESTIGATION OF THE NUCLEATION  
AND GROWTH OF SPUTTERED THIN FILMS \$ 42,000 01-01  
T. E. Hutchinson - Dept. of Chemical  
Engineering and Materials Science

Nucleation and growth of thin films, "in-situ" ion beam sputtering, transmission electron microscopy, role of adatom energy, characterization of film nuclei, Ag on mica or graphite, Nb on graphite.



## MINNESOTA, UNIVERSITY OF (Continued)

257. DIFFUSION STUDIES IN LIQUID METALS           \$ 60,794    01-02  
R. A. Swalin - Dept. of Chemical  
Engineering and Materials Science

Mechanism of atomic transport in liquids, thermotransport and electrotransport, liquid Ag alloys, liquid Na alloys, radio-tracer analysis, heat of transport, electrotransport efficiency, self diffusion in liquid Rb.

## MONTANA STATE UNIVERSITY

258. HIGH-TEMPERATURE OXIDATION  
OF IRIDIUM   \$ 26,016    01-01  
R. T. Wimber - Dept. of Aerospace  
and Mechanical Engineering

Ir oxidation rates in the range 1600-2200°C and pressures 1-1000 torr, high temperature thermal expansion, emissivity, electrical resistivity, oxidation rates under conditions where heat transfer coefficients are known and may be used in the calculation of the mass transfer coefficients.

## NEW YORK, STATE UNIVERSITY OF

259. THEORY OF REACTION KINETICS               \$ 39,000    02-03  
J. W. Corbett - Dept. of Physics,  
Albany

Role of spatial correlation on reaction kinetics, recovery in discrete lattices and simultaneous production and diffusion-limited recovery, continuum theory of the role of correlation in diffusion-controlled reaction kinetics, relationship between continuum results and discrete results, applications of theory to radiation damage, radiation chemistry, photo-chemistry, ionization yields, molecular theory of nucleation.

## NEW YORK, STATE UNIVERSITY OF

260. SLIP INITIATION AND MICRO-  
DYNAMICS OF PLASTIC FLOW \$ 32,000 01-01  
J. C. Bilello - Dept. of Materials  
Science, Stony Brook

Correlation between microdynamical behavior of defects and observed macroscopic mechanical properties, mechanical behavior of pure BCC metals, role of interstitial impurities on microdynamics of dislocations in W, solute hardening in Cu base alloys, flow properties of polycrystalline metals, high sensitivity strain measuring techniques.

261. FATIGUE-ENHANCEMENT OF DIFFUSION \$ 14,432 01-01  
H. Herman - Dept. of Materials  
Science, Stony Brook

Enhanced diffusion during low amplitude cyclic straining of alpha brass, electrical resistivity measurements, experimental and theoretical studies of the kinetics of ordering.

## NORTH CAROLINA STATE UNIVERSITY

262. DIFFUSION OF GASES IN SOLIDS \$ 28,500 01-03  
T. S. Elleman - Dept. of Nuclear  
Engineering

Tritium diffusion rates in stainless steel and zircaloy-2, effects of rare gas concentration and radiation damage on rare gas diffusion in ionic solids, trapping behavior of gases in solids, diffusion models to predict tritium transport through claddings, Xe diffusion in single crystal UO<sub>2</sub>.

## NORTH CAROLINA, UNIVERSITY OF

263. INVESTIGATION OF DEFECT STRUCTURES  
BY ELECTRIC POLARIZATION AND  
RELAXATION METHODS \$ 26,286 02-02  
J. H. Crawford, Jr. - Dept. of Physics

Structures and symmetries of composite defects in alkali and alkaline earth halides, dielectric loss and ionic thermocurrent techniques, polarized luminescence, photoconductivity, EPR, NMR, optical absorption, rare earth-fluoride interstitial dipoles in CaF<sub>2</sub>.

## NORTH CAROLINA, UNIVERSITY OF (Continued)

264. THE PROPERTIES OF METALS AND ALLOYS      \$ 60,000      02-02  
L. D. Roberts - Dept. of Physics

Electron charge density, electrical resistance, magnetic properties, Au and Fe alloys, Mössbauer effect, x-ray chemical shift studies, high pressure-low temperature electrical resistance measurements, Kondo effect, theoretical studies using pseudo-potential method.

265. PRESSURE VARIATION OF SINGLE  
CRYSTAL ELASTIC CONSTANTS      \$ 21,960      02-02  
C. S. Smith - Dept. of Physics

Pressure and temperature derivatives of the adiabatic elastic constants, thermal expansion coefficients, KCl-KBr mixed crystals, lattice distortions in the mixed crystals, microscopic nature of the repulsive interaction between closed shell ion-cores, equation of state for LiH.

## NORTHWESTERN UNIVERSITY

266. EFFECT OF POINT DEFECTS ON  
MECHANICAL PROPERTIES OF METALS      \$ 48,528      01-03  
M. Meshii - Dept. of Materials  
Science

Interstitial atom defects produced in metal crystals by irradiation with 1-2 MeV electrons at low temperatures, lattice vacancies by quenching, interactions between dislocations and point defects, Fe, Nb.

## OHIO STATE UNIVERSITY

267. LIQUID METALS RESEARCH      \$ 37,972      01-02  
D. A. Rigney - Dept. of Metal-  
lurgical Engineering

Electrotransport measurements in liquid alloys, Na-K-Nb, Na-K, Na-Rb, Li-Ag, transition metal solutes in liquid Cu and Al, phase shift calculations.

## OKLAHOMA, UNIVERSITY OF

268. THERMOELECTRIC SIZE EFFECT  
IN NOBLE METALS \$ 28,266 02-02  
R. R. Bourassa - Dept. of Physics  
and Astronomy

Thermoelectric size effects in Au Cu Ag, size effect on the phonon drag component, thermoelectric power of lattice vacancies in Al.

## OREGON STATE UNIVERSITY

269. NATURAL CONVECTION HEAT  
TRANSFER IN LIQUID METALS \$ 21,210 01-01  
J. R. Welty - Dept. of Mechanical  
and Nuclear Engineering

Energy exchange by natural convection between heated surfaces and liquid metals, Hg, numerical solutions to the governing differential equations of momentum, energy and mass conservation relating temperature and velocity to various geometrics and surface boundary conditions, experimental program to obtain temperature and velocity profiles.

## PENNSYLVANIA STATE UNIVERSITY

270. CERAMIC RESEARCH \$ 28,000 01-01  
R. C. Bradt and J. H. Hoke -  
Dept. of Material Sciences

Superplastic behavior in Bi oxide systems, transmission electron microscopy of ferroelectric domain boundaries in single crystal and polycrystalline BaTiO<sub>3</sub>.

271. THERMODYNAMIC PROPERTIES OF SOLID  
SOLUTIONS AT HIGH TEMPERATURES \$ 27,301 01-02  
A. Muan - Dept. of Geosciences

Equilibrium relations in selected parts of the MgO-NiO-FeO-SiO<sub>2</sub> system, phase relations and thermodynamics of solid solution phases in the system ZnO-NiO-SiO<sub>2</sub>, equilibrium relations in spinel solid solutions.

## PENNSYLVANIA, UNIVERSITY OF

272. DISLOCATION MOBILITIES  
 IN ORDERED ALLOYS \$ 28,000 01-01  
 D. P. Pope - Dept. of Metallurgy  
 and Materials Science

Dislocation velocities in ordered  $\text{Cu}_3\text{Au}$ , correlation of dislocation properties with gross mechanical behavior, single crystal studies, flow stress of  $\text{Cu}_3\text{Au}$  from 77 to  $695^\circ\text{K}$ .

## PITTSBURGH, UNIVERSITY OF

273. PRECIPITATION HARDENING IN  
 COPPER-TITANIUM ALLOYS \$ 29,000 01-02  
 W. A. Soffa - Dept. of Metal-  
 lurgical and Materials  
 Engineering

Structure and properties of age hardening Cu-Ti alloys, transmission electron microscopy, electron diffraction, flow stress of single and polycrystalline specimens, development of modulated microstructures in "side-band" alloys.

274. THERMAL, STRUCTURAL AND  
 MAGNETIC STUDIES OF METALS  
 AND INTERMETALLIC COMPOUNDS \$ 95,213 02-02  
 W. E. Wallace and R. S. Craig -  
 Dept. of Chemistry

Heat capacity measurements on intermetallic compounds, pulse calorimeter, rare earth compounds,  $\text{R.E.Co}_5$ , ferromagnetic coupling between heavy lanthanide and 3-d transition metal atoms, effects of de-gasing on properties of intermetallic compounds, Curie temperature, saturation magnetization, direction of easy axis of magnetization, anisotropy field, coercivity, permanent magnets involving lanthanide elements.

## PURDUE UNIVERSITY

275. DIFFUSION AND PRECIPITATION  
OF INERT GASES IN METALS \$ 28,000 01-03  
J. R. Cost - School of Materials  
Science and Metallurgical  
Engineering

Investigation of the initial stages of precipitation of inert gases in metals, characterization of the kinetics and mechanism for coalescence of bubbles of inert gases in metals, Al-He, Nb-He, elastic modulus, low angle x-ray scattering, internal friction, electron microscopy, computer-simulated bubble coalescence.

276. TRANSPORT AND THERMODYNAMIC  
PROPERTIES OF SOLIDS \$ 36,212 01-02  
R. E. Grace - School of Materials  
Science and Metallurgical  
Engineering

Atomic transport, lattice defects, interfacial reactions in solid multicomponent alloys, oxides, sulphides, intermetallic compounds, intrinsic diffusion coefficients, interdiffusion coefficients, Ag-Cd, Ag-Zn, Ni-Al, Fe-Ni-Al, Cu-Zn-Ni, electron microprobe analysis, thermogravimetric methods used to study formation of iron sulphide on wustite substrates.

## RENSSELAER POLYTECHNIC INSTITUTE

277. EFFECT OF HYDROSTATIC PRESSURE  
ON SELF-DIFFUSION RATES IN  
HEXAGONAL METALS \$ 40,000 02-02  
H. M. Gilder - Dept. of Physics  
and Astronomy

Vacancy thermal expansion in Zn, Tl, Bi, Pb, anomalous diffusion in BCC metals, activation volume for self diffusion as a function of temperature, radiotracer and lathe-sectioning technique, pressure vessel submerged in molten Sn bath to provide accurate temperature environment.

## RENSSELAER POLYTECHNIC INSTITUTE (Continued)

278. ANISOTROPIC DIFFUSION AND  
ELECTROMIGRATION \$ 52,500 02-02  
H. B. Huntington - Dept. of Physics  
and Astronomy

Impurity diffusion, Zn in Sn, impurity enhancement of self-diffusion, double isotope studies, electromigration of H and D through Ag, electromigration of Ag through Zn crystals.

279. RESEARCH IN POWDER METALLURGY \$ 29,000 01-01  
F. V. Lenel - Materials Division

Sintering of thin metallic disks in situ in the electron microscope, sintering of Ag-4% Cu wires, growth of necks and increase in radii of curvature at the neck in the interior of Fe powder compacts, scanning electron microscopy, tensile strength of compacts, correlation with particle geometry and pore structure.

280. PRECIPITATION AND DISPERSION  
HARDENING IN HEXAGONAL ALLOYS \$ 25,000 01-01  
N. S. Stoloff - Materials Division

Role of second phases in the plastic deformation and fracture of metals of HCP structure, effect of O and H on embrittlement of Hf, mechanism of hydride strengthening in Hf, strengthening produced by unidirectional solidification of eutectic Mg-Al alloys, composite structures versus precipitation hardened Mg.

## STANFORD UNIVERSITY

281. STRUCTURE DEPENDENCE OF HIGH  
TEMPERATURE DEFORMATION OF METALS \$ 43,000 01-01  
C. R. Barrett and W. D. Nix -  
Dept. of Materials Science  
and Engineering

Structure dependence of high temperature deformation of metals, structure and properties of ultra fine grained refractory metals produced by vapor deposition, effects of He bubbles on creep, high temperature failure mechanisms, grain boundary sliding kinetics, plastic zone effects.

## STANFORD UNIVERSITY (Continued)

282. NITRIDE FORMING REACTIONS IN  
LIQUID URANIUM ALLOYS \$ 47,272 01-01  
N. A. D. Parlee - Dept. of  
Applied Earth Sciences

*Kinetics of UN and U<sub>2</sub>N<sub>3</sub> formation and decomposition reactions in liquid U-Sn alloys, N-nitride equilibria, physical nature of the uranium nitride precipitates formed in the liquid U-Sn alloy, effect of fission product nitride formers, applications to the reprocessing of nuclear fuels.*

## TENNESSEE, UNIVERSITY OF

283. MICROSTRUCTURE-PROPERTY  
RELATIONSHIPS IN AUSTENITIC  
STAINLESS STEELS \$ 19,000 01-01  
J. E. Spruiell - Dept. of Chemical  
and Metallurgical Engineering

*Microstructural stability of types 316, 304 and 316-Ti stainless steel, effects of varying solution treatment temperature, amount of cold rolling, initial grain size, initial precipitate distribution.*

284. APPLICATION OF ADIABATIC  
CALORIMETRY TO METAL SYSTEMS \$ 26,653 01-01  
E. E. Stansbury and C. R. Brooks -  
Dept. of Chemical and  
Metallurgical Engineering

*Heat capacity of Pt from 20-1000°C, heat capacity of Bi and Sn from 25°C into the liquid phase, calorimetric study of annealing of irradiation-induced defects in high purity Al.*



## TEXAS, UNIVERSITY OF

285. ELEVATED TEMPERATURE MORPHOLOGICAL STABILITY OF METAL MATRIX FIBER COMPOSITES \$ 20,488 01-01  
T. H. Courtney - Dept. of Mechanical Engineering

Mechanism and kinetics associated with morphological instabilities in metal matrix fiber composites, surface characteristics of fiber matrix interface, Al-Al<sub>3</sub>Ni, Cu-Cr, Pb-Sn.

## UTAH, UNIVERSITY OF

286. POSITRON LIFETIME MEASUREMENTS AS A NON-DESTRUCTIVE TECHNIQUE TO MONITOR FATIGUE DAMAGE \$ 29,884 01-01  
J. G. Byrne - Division of Materials Science and Engineering

Distribution of positron lifetimes to measure the degree of plastic fatigue damage, Ni, Cu, Al, effect of grain size, effect of tensile strain, fatigue damage correlated to transmission electron microscopy.

287. IMPURITY EFFECTS ON THE CREEP OF POLYCRYSTALLINE MAGNESIUM AND ALUMINUM OXIDES AT ELEVATED TEMPERATURES \$ 25,000 01-01  
R. S. Gordon - Division of Materials Science and Engineering

Steady state and transient creep under four-point bending conditions, dense polycrystalline MgO and Al<sub>2</sub>O<sub>3</sub>, effect of transition metal additives, Fe Cr Ti, effect of various stress levels and oxygen partial pressures, stabilized grain sizes, relative roles of diffusional unaccommodated grain boundary sliding and dislocation mechanisms in high temperature creep, role of lattice defects created by solid solution impurities.

## UTAH, UNIVERSITY OF (Continued)

288. THE FUNDAMENTALS OF  
RADIATION DAMAGE \$ 74,358 02-03  
A. Sosin - Dept. of Physics

Dislocation pinning in Cu and Al, Stage I recovery in Cu, study of Mattheissen's Rule using controlled defect concentrations, effect of pressure on Stage III recovery in Ni.

## VERMONT, UNIVERSITY OF

289. THERMODYNAMIC AND TRANSPORT  
PROPERTIES OF INTERSTITIAL  
HYDROGEN ISOTOPES IN PALLADIUM \$ 20,583 02-02  
J. S. Brown - Dept. of Physics

Theoretical studies of electronic and thermodynamic properties of interstitial hydrides of Pd, phase shift parametrization techniques based upon pseudopotential theory, also pseudo-Greenian techniques, electronic propagation in disordered interstitial alloys, phonon dispersion and dielectric screening in pure Pd.

## VIRGINIA, UNIVERSITY OF

290. ELECTRONIC PROPERTIES OF  
METALS AND ALLOYS \$ 73,000 02-02  
R. V. Coleman - Dept. of Physics

Measurement and elucidation of electronic processes in metals and alloys, transition metals and transition metal compounds, Fe Co Ni, NbSe<sub>2</sub>, TaSe<sub>2</sub>, NbTe<sub>2</sub>, Fe<sub>3</sub>O<sub>4</sub>, Ti<sub>2</sub>O<sub>3</sub>, high field magnetoresistance, Hall effect, thermal conductivity, electron tunneling, ferromagnetic oxide barriers, spin dependent tunneling processes, optical reflectivity, anisotropic electronic properties of dichalcogenide layer compounds.

## VIRGINIA, UNIVERSITY OF (Continued)

291. INVESTIGATIONS ON THE BEHAVIOR  
OF POINT DEFECTS AND DISLOCATIONS \$ 68,000 02-02  
D. Kuhlmann-Wilsdorf - Depts. of  
Materials Science and Physics

Relationship between elastic constants and interatomic potentials, collapse of voids in metals under stress, defect calculations employing near-neighbor non-central interactions, melting of small particles, martensitic transformations in thin films, elastic strains in epitaxial island overgrowths, radiation damage in thin films, stress distributions about dislocation arrays, properties of single crystals with low content of vacancy condensation products.

292. DYNAMIC DISLOCATION PHENOMENA  
IN SINGLE CRYSTALS OF METALS  
AND ALLOYS \$ 61,454 02-02  
J. W. Mitchell - Dept. of Physics

Factors determining the velocity of edge dislocations between 4°K and room temperature, single crystals of alpha Cu-Al, strain-time stress-time measurements made with differential capacitors, strain gauges and piezoelectric transducers, second and third order elastic constants.

## WASHINGTON, UNIVERSITY OF

293. MOSSBAUER STUDIES AT HIGH PRESSURE \$ 34,000 02-02  
R. L. Ingalls - Dept. of Physics

Measurement of Mössbauer effect in solids at pressures up to 300 Kbar, internal magnetic field, isomer shift, phase changes in transition metals, alloys and compounds containing <sup>57</sup>Fe, Invar alloys, measurements down to 10°K.

294. A STUDY OF PHASE TRANSFORMATIONS  
AND SUPERCONDUCTIVITY \$ 36,678 01-01  
D. H. Polonis - Dept. of Mining,  
Metallurgical and Chemical  
Engineering

Control of phase transformation phenomena in Ti and Zr base alloys, role of lattice defects in the decomposition of metastable beta, kinetics of omega phase formation, phase separation in Zr-Nb and Zr-Ta binary alloys, mechanical and superconducting properties, effect of ternary element additions on T<sub>c</sub>.

## WAYNE STATE UNIVERSITY

295. ELECTRON PARAMAGNETIC RESONANCE  
STUDIES OF RADIATION EFFECTS IN  
SOLIDS AND CHEMICAL COMPOUNDS \$ 38,500 02-03  
Yeong-Wook Kim - Dept. of Physics

Effects of defects introduced by radiation or doping on superconducting properties or optical properties, microwave spectroscopy, optical spectroscopy, electron-nucleus double resonance, magnetization, electron tunneling, alkali halides, phosphors, superconducting materials.

## WISCONSIN, UNIVERSITY OF

296. VOID NUCLEATION AND GROWTH IN  
HEAVY ION AND ELECTRON  
BOMBARDED PURE METALS \$ 60,000 01-03  
G. L. Kulcinski - Dept. of  
Nuclear Engineering

Nucleation and growth of voids in pure Al and V, high energy beams of Al or V ions used for irradiation, electron irradiation also, selected doping with He and H.



## SECTION C

### Summary of Funding Levels

The summary funding levels for various research categories were determined from the index listing in Section D and estimating the percentage from the project devoted to a particular subject. There is overlap in the figures. For instance, funding for a project on diffusion in oxides at high pressure would appear in all three categories of diffusion, oxides, and high pressure.

SUMMARY OF  
FUNDING LEVELS

During the fiscal year ending June 30, 1972, the Metallurgy and Materials Programs total support level amounted to about \$25.2 million in operating funds and \$1.3 million in equipment funds. These separately identified equipment funds are expended primarily at AEC Laboratories and are not shown in this report. Equipment funds for the University projects are included in the total contract dollars, being part of the operating budget. The following analysis of costs is concerned only with the \$25.2 million operating funds.

1. By Region of the Country:

	<u>Contract Research (%)</u>	<u>Total Program (%)</u>
(a) Northeast ..... (Mass., R.I., Penn., N.Y., N.H., D.C., Md., Vt.)	44.5	20.6
(b) South ..... (Fla., Ga., N.C., Tenn., Ala., Va., Puerto Rico)	9.7	22.8
(c) Midwest ..... (Ohio, Ill., Wisc., Mich., Minn., Ind., Iowa)	23.5	42.6
(d) West ..... (Ariz., Utah, Calif., Colo., Mont., Okla., Ore., Texas, Wash., Hawaii)	22.3	14.0

2. By Academic Department or Laboratory Division:

	<u>Contract Research (%)</u>	<u>Total Program (%)</u>
(a) Metallurgy, Materials Science, Ceramics, Other Engineering (Office Budget Activity Numbers 01-) .....	53.1	45.1
(b) Physics, Solid State Science, Solid State Physics (Office Budget Activity Numbers 02-) .....	46.9	54.9

SUMMARY OF  
FUNDING LEVELS

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3. By AEC Laboratory and University:

	<u>Total Program (%)</u>
(a) University Program (including those laboratories where graduate students are involved in research to a large extent) .....	42.5
(b) Laboratory Program .....	57.5

4. By Laboratory:

	<u>Total Program (%)</u>
Ames Laboratory .....	10.3
Argonne National Laboratory .....	22.1
Brookhaven National Laboratory .....	11.8
Illinois, University of (Materials Research Laboratory) .....	4.8
Lawrence Berkeley Laboratory .....	7.1
Mound Laboratory .....	0.4
Oak Ridge National Laboratory .....	20.7
Pacific Northwest Laboratory .....	2.4
Puerto Rico Nuclear Center .....	0.3
Contract Research .....	20.1



SUMMARY OF  
FUNDING LEVELS

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5. By Selected Areas of Research:

	Number of Projects (Total=201) <u>(%)</u>	Total Program \$ <u>(%)</u>
(a) Materials		
Actinide Metals and Compounds .....	9.5	7.1
BCC Refractory Metals .....	20.4	8.0
Ceramics .....	20.4	11.4
Rare Earth Metals and Compounds .....	9.5	6.7
(b) Technique		
Neutron Scattering .....	9.5	16.0
Theory .....	11.0	7.4
(c) Phenomena		
Diffusion .....	12.0	6.5
Strength .....	17.0	8.4
Superconductivity .....	17.4	8.7
Surface Phenomena and Thin Films .....	19.9	10.5
Void Formation .....	5.5	4.7
(d) Environment		
High Pressure .....	7.5	4.3
Hydrogen .....	5.0	1.5
Radiation .....	19.4	16.6

SECTION D

Index of Investigators,  
Materials, Phenomena,  
Technique and Environment

The index refers to project numbers in Sections A and B.



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MATERIALS

- A6 -

Actinide Metals and Compounds 9.5%# - 7.1%#

2	87
5	88
17	95
21	103
22	104
31	211
32	247
80	262
85	282
86	

Ceramics 20.4%# - 11.4%#

<u>Carbides</u>	<u>Glass</u>	<u>Nitrides</u>	<u>Oxides</u>			
22	68	50	3	41	87	242
63	69	94	13	67	90	247
81	215	282	17	68	92	253
88			18	69	95	262
91			22	70	97	270
94			25	74	98	271
100			26	81	104	276
			32	84	236	287
						290

Composites

5	87
36	238
37	241
53	280
71	285
73	

Graphite and Carbon

26
28
71
94
238
239
245

Intermetallic Compounds

17	96
21	103
22	209
23	223
35	235
36	239
38	244
73	252
75	272
85	

Ionic Crystals

Alkali Halides

14	97
15	214
25	228
27	229
47	246
60	263
62	265
82	295

Other

11	94
25	97
26	208
34	211
38	214
40	216
42	237
67	238
70	263
74	270
90	295

Liquids

12
15
26
30
80
257
267
269
282

MATERIALS

- A8 -

Metals

Alkali

HCP

BCC Refractory

Ferrous

12	1	105	1	90	4	219
18	2	233	2	92	5	224
89	4	249	5	93	50	253
201	23	258	6	102	51	254
229	31	262	7	105	58	262
230	48	277	9	213	63	264
246	49	280	14	217	66	266
257	51	294	15	219	67	276
267	83		18	222	90	279
	94		23	223	96	283
			50	224	203	290
			52	225	213	293
			55	243	215	
			57	251		
			72	260		
			82	266		
			83	275		
			84	277		
			85	281		
			86	296		
			88			

*Body Centered Cubic*  
 $\rightarrow 20.4\% \# - 8.0\% \#$

Organics

238

Rare Earth Metals and Compounds

$9.5\% \# - 6.7\% \#$

3	41
4	42
8	58
9	80
16	94
18	96
25	100
31	208
32	274
38	

Semiconductors

13	75
15	77
25	78
46	92
63	204
64	216
69	236

Solid and Liquid Inert Gases

12	94
15	202
28	210
30	212
39	221
44	246
61	250
76	255

## Acoustic Emission

54  
240  
254

## Computer Simulation

19        207  
65        232  
84        244  
100       275  
205

## Elastic Constants

3        229  
4        265  
18       275  
59       292

## Electron Microscopy

7        70        105       215       256  
24       81        204       217       270  
56       84        205       232       283  
67       91        206       244       286  
69       99        213       252       296

## Electron Scattering

6        101  
35       204  
45       236

## Electron Spin Resonance

27       95        212  
30       97        263  
32       211       295

Field Ion Microscopy

55  
69  
222

High Temperature Heat Capacity

4  
16  
274  
284

Infrared Spectroscopy

9  
76  
77  
228  
237

Internal Friction

7  
17  
46  
52  
57  
63  
80  
102  
213  
235  
275

Laser Beam Scattering

29  
76  
77  
78  
216  
221

## Low Temperature Specific Heat

4  
12  
13  
17  
21  
28  
83  
239  
274

## Magnetic Susceptibility

4	17
9	18
13	51
16	208

## Mossbauer Effect

10	214
31	218
58	264
204	293

## Neutron Scattering

9.5%# - 16.0%#

4	38	48
15	39	91
22	40	94
26	41	96
30	42	244
33	43	246
		248

## Nuclear Magnetic Resonance

9	62
10	204
21	208
30	249
55	263

## Optical Absorption

14  
16  
47  
58  
77  
97  
295

## Positron Annihilation

21  
46  
286

## Sputtering

13  
56  
101  
103  
209  
256

Theory 11.0%# - 7.4%\$

9	75	207
11	84	214
14	89	220
21	100	226
33	105	255
44	201	259
49	203	289
		291

## Thermal Conductivity

3	228	249
82	230	250
219	239	269



## Channeling

20  
46  
64  
98

## Crystal Structure, Atomic Distribution and Crystal Transformations

4            87  
30          94  
50          103  
56          204  
67          223  
80          246  
81          291  
            294

Diffusion *12.0%# - 6.5%#*

5	60	212	262
6	68	242	267
18	70	247	275
20	86	257	276
30	90	259	277
55	202	261	278

## Dislocations

7            84  
19          85  
36          91  
49          99  
52          205  
53          222  
59          272  
63          291  
65          292  
69

## Electron Transport

13	82
17	230
33	245
60	268
	290

## Electronic Structure

<u>Fermi Surface</u>	<u>Other</u>	
9	9	62
31	17	75
60	21	76
89	31	89
201	44	95
234	51	211
	58	231

## Magnetism

4	42	96	230
10	44	100	255
21	51	204	274
22	62	208	293
33	94	218	

## Materials Preparation and Characterization

2	92
8	204
25	247
87	

## Phonons

15	100
38	216
39	223
76	226
82	230
94	249

## Point Defects

7	61	105
20	64	207
23	69	217
24	84	222
27	91	242
34	95	263
37	97	266
49	99	288
52	102	291

## Precipitation

1	215
20	232
55	259
84	273
91	275
206	282
207	

## Recovery and Recrystallization

67	252
69	283
85	288

## Sintering

70
72
247
279

## Solidification

5
6
71

Strength 17.0%# - 8.4%#

	<u>Fracture</u>	<u>Super- plasticity</u>	<u>Creep</u>	<u>Flow Stress</u>		
	1	253	65	1	205	244
	68	254	270	65	206	247
	203	280		68	213	251
	224	281	281	65	227	260
	238	286	287	66	233	272
				81	235	273
				84	240	280
				85	243	286
						292

## Stress-Corrosion Cracking

54  
224  
253  
254

Superconductivity 17.4%# - 8.7%#

4	29	38	73	83	223	241
11	33	45	75	93	225	249
13	35	46	76	103	231	255
21	36	59	78	204	234	294
23	37	72	79	209	239	295

Surface Phenomena and Thin Films 19.9%# - 10.5%#

6	53	73	91	204	225	268
14	54	74	98	209	227	270
24	55	78	99	214	236	285
29	56	79	101	215	239	290
35	67	81	103	221	253	291
45	69	86	105	222	256	

Void Formation 5.5%# - 4.7%#

7	85	217
20	91	220
23	105	259
24	206	296

## Electric Field

5  
27  
257  
267  
278

## Gas

Oxidizing

86  
258  
280

Hydrogen

1	223
18	224
52	262
57	280
90	289

## Magnetic Field

4	40	228
8	42	230
9	51	239
14	55	245
16	83	248
17	94	255
21	96	274
27	208	290
31	209	293

## Pressure

Above Atmospheric

18	229
26	245
31	264
58	265
60	277
202	288
214	293
228	

Radiation						
<u>Electron</u>	<u>Ion</u>		<u>Neutron</u>		<u>Theory</u>	<u>Gamma</u>
37	23	98	7	102	20	47
46	24	103	23	105	49	95
64	34	104	88	217	100	97
67	37	105	91	225	220	295
69	46	206	93	237	259	
91	64	222	95	243		
99	69	262	99	284		
215	91	296				
266						
288						
296						

Temperature  
Below Liquid Helium (4.2°K)

12	79
21	209
28	210
30	228
35	234
45	239
60	255
	274