

# METALLURGY

*and*

# MATERIALS

# PROGRAMS



FY 1971

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

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METALLURGY  
AND  
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Fiscal Year 1971

July 1971

U. S. Atomic Energy Commission  
Division of Research

## FOREWORD

The Metallurgy and Materials Program constitutes one portion of a wide range of research supported by the AEC Division of Research. Other programs are administered by the Division's Controlled Thermonuclear Research, 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 1971 together with a convenient index to the program.

Donald K. Stevens  
Assistant Director of Research for  
Metallurgy and Materials Programs  
Division of 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 1971 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 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 1971.

## 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 \$169,000 01-01  
D. T. Peterson, T. E. Scott

Mechanism of second phase particle strengthening in metals, Cu-Co alloys, particle size distributions, fatigue behavior, flow stress of Th-N Th-Zr alloys, effect of second phase particles on mechanical behavior of BCC metals, V alloys, H embrittlement of V Ta, ductile-brittle transition in BCC metals, effect of irradiation on deformation of Th, effects of second phase particles on strength in Th-Zr-C and Th-Cr alloys.

2. METAL PURIFICATION AND IMPURITY \$77,000 01-01  
EFFECT STUDIES  
O. N. Carlson, D. T. Peterson,  
F. A. Schmidt, H. A. Wilhelm

Metallothermic reduction of refractory oxides, C reduction of UO<sub>3</sub> U<sub>3</sub>O<sub>8</sub> UO<sub>2</sub>, single crystals of V Cr Ta Nb Er, electrotransport purification technique for V Th Mo, vacuum sublimation of Mn, Sc metal preparation.

3. CERAMICS RESEARCH \$119,000 01-01  
O. Hunter, D. R. Wilder

Grain growth in Y<sub>2</sub>O<sub>3</sub>, flash method for thermal transport properties in TiB<sub>2</sub> ZrB<sub>2</sub> HfB<sub>2</sub>, thermal shock resistance of Nb<sub>2</sub>O<sub>5</sub>, Er oxide-Hf oxide phase diagram, interdiffusion studies in CaF<sub>2</sub>-SrF<sub>2</sub>, oxidation of high purity rare earths, mechanical and thermal properties of HfO<sub>2</sub>-rare earth oxide systems.

4. PHYSICOCHEMICAL PROPERTIES \$361,500 01-02  
D. M. Bailey, P. Chiotti, F. X. Kayser,  
K. A. Gschneidner, O. D. McMasters,  
J. F. Smith, D. E. Williams

Vapor pressure measurements on Mg-rare earth alloys, elastic constants of Fe-Ni-C, crystal structure determination for Au-rare earth compounds, physicochemical properties of alkaline earth metals Ba Sr, elastic constants and magnetic susceptibility on Tl-Bi Bi-In alloys, low temperature heat capacity measurements of (La, Y)Mn<sub>2</sub> and (Y, Lu)Mn<sub>2</sub> ternary Laves phases.



## AMES LABORATORY

Metallurgy Division -01- (Continued)

5. DIFFUSION AND TRANSPORT PROPERTIES                      \$93,000              01-02  
     O. N. Carlson, D. T. Peterson,  
     F. A. Schmidt, J. D. Verhoeven

Solidification in Sn alloys, electromigration velocities and diffusion coefficients of C in Nb Ta, alloy diffusion in Th-rare earth systems, electron microprobe technique, interstitial electromigration of O N C in Gd, growth of off-eutectic composite alloys in Pb-Sn system, diffusion of C in Mo, C O N in U and Sc, thermotransport of interstitials in metals.

6. PROPERTIES OF SURFACES                                      \$50,500              01-02  
     R. K. Trivedi

Theoretical study of dendrite growth at solid-liquid interface in a two-component system, experimental study of instability of interface shape in Cu-Zn system, LEED and Auger apparatus, effects of alloying additions, adsorbed layers and crystalline imperfections on surface mobility, mobility of surface atoms on V using a laser diffraction technique.

7. RADIATION DAMAGE    \$130,000              01-03  
     C. W. Chen, M. S. Wechsler

Neutron damage to physical and mechanical properties of BCC metals, V alloys, internal friction, resistivity, transmission electron microscopy, radiation hardening, annealing stages in high purity V, formation of voids in various metals.

Physics Division -02-

C. A. Swenson - Phone: 294-5288

8. MATERIALS PREPARATION  
     AND CHARACTERIZATION                                      \$170,000              02-01  
     F. H. Spedding, G. Burnet

Preparation of pure rare earth metals and single crystal preparation, high purity fluorides, magnetic behavior and thermodynamic properties of rare earth fluorides, phase studies of intra-rare earth alloy systems.

## AMES LABORATORY

Physics Division -02- (Continued)

9. ELECTRONIC STRUCTURE AND MAGNETIC  
 PROPERTIES OF METALS \$288,500 02-02  
 S. Legvold, S. H. Liu, J. L. Stanford,  
 R. P. Gupta, L. Hodges

Theoretical study of exchange enhancement in transition metals, Fermi surface of Fe, dHvA measurements in Mo Cr-alloys, energy band calculations in intermetallic compounds, magnetoelastic interactions in heavy rare earths, ferromagnetic resonance in Dy, microwave absorption in Er, Kondo effect, radio frequency size effect in Tl, electromagnetic wave propagation in Mo V.

10. NUCLEAR RESONANCE IN SOLIDS \$112,000 02-02  
 R. G. Barnes, D. R. Torgeson

Studies of NMR ESR and NGR to metallic and/or magnetic solids, transition metal borides, hyperfine-enhanced NMR of Tm and Pr, metallic compounds of P S and Se.

11. SUPERCONDUCTIVITY \$144,000 02-02  
 D. K. Finnemore, J. R. Clem,  
 W. J. Keller, J. E. Ostenson

Theoretical studies of effects produced by the motion of magnetic flux in superconductors, flux pinning, superconductivity in highly anisotropic (Th) materials, susceptibility and specific heat measurements on La-Ce alloys, surface superconductivity in Nb-Ta alloys, electron-phonon interaction in the superconducting layer structure compounds using transport and electron tunneling measurements.

12. LOW TEMPERATURE, HIGH  
 PRESSURE STUDIES \$144,000 02-02  
 C. A. Swenson, D. Guban

Specific heat of solid Ne, equation of state for inert gas solids, thermal expansion of noble metals, low temperature thermometry, dilatometry on Na K Li, low temperature thermodynamic data on Ca Ba Sr, high pressure measurements on solid Xe H<sub>2</sub> D<sub>2</sub> N<sub>2</sub>.

## AMES LABORATORY

Physics Division -02- (Continued)

13. TRANSPORT PROPERTIES OF SOLIDS \$224,500 02-02  
G. C. Danielson, P. H. Sidles,  
H. R. Shanks

Semiconductors, amorphous solids, layer compounds,  $\text{NbSe}_2$ , electrical resistivity, thermal conductivity, Hall effect, Seebeck effect, Te-As-Ge glasses, superconductivity of  $\text{Rb}_x\text{WO}_3$   $\text{NbSe}_2$ , transport properties of NiS.

14. OPTICAL PROPERTIES OF SOLIDS \$192,000 02-02  
D. W. Lynch, R. Fuchs, K. L. Kliewer,  
C. G. Olson, R. Rosei

Optical studies on solids using synchrotron radiation Cd Cr, Stark effect for excitons in K halides, infrared absorption in Cr-Fe alloys Ni Ni-Cu alloys  $\text{ReO}_3$ , surface plasmons in thin metallic films, local mode absorption of  $\text{H}^-$  and  $\text{D}^-$  impurities in CsBr and CsI.

15. LATTICE DYNAMICS AND NEUTRON SCATTERING FROM SOLIDS \$160,500 02-02  
S. K. Sinha, R. A. Reese, T. O. Brun,  
J. C. Traylor, G. Kline, C. Stassis

Magnetic scattering of neutrons from  $\text{CsNiCl}_3$ , lattice dynamics of Th, magnetic structure of Ho-Sc alloy, generalized screening model for lattice dynamics, phonon dispersion curves in the alkali metals, excitation spectrum of single crystal FCC D, phonon spectrum of FCC He, application of white neutron beams in conjunction with inelastic neutron scattering, spatial distributions of trapped electrons in color centers in ionic crystals, magnetic field distribution inside vortex lines in type II superconductors.

16. OPTICAL AND MAGNETIC PROPERTIES OF RARE EARTH SALTS, SOLUTIONS, METALS AND ALLOYS \$208,500 02-02  
F. H. Spedding, R. H. Good

Laser Raman spectra, absorption spectra, electrical resistivity, heat capacity, magnetic susceptibility, spectra of rare earth ions in crystal fields, absorption spectrum and Zeeman effect for Dy and Er ethylsulfate, heat capacity of Lu Y Sc, magnetic structure of Tb-Ho single crystal alloys, low temperature absorption spectra and Zeeman effect of single crystals of anhydrous Er and Ho fluoride.

## ARGONNE NATIONAL LABORATORY

9700 South Cass Avenue

Argonne, Illinois 60439

Phone: Area Code 312 739-7711

Materials Science Division -01-

P. G. Shewmon - Phone: 739-2221

N. L. Peterson - Phone: 739-2222

17. PHYSICAL METALLURGY \$328,000 01-01  
M. B. Brodsky, A. J. Arko,  
J. J. Rechten

Research on actinide metals and alloys, preparation of high purity Pu and Np and single crystal Pu, mechanical properties of Pu single crystals, transformation studies of Pu and Np, electron transport and magnetic studies of Pu U Cm Pd-U Th-Np U-Np, neutron diffraction studies of Pu-U-Al and Pu-Pd intermetallic compounds, NGR and NMR studies of Np Pu Am Cm systems, Fermi surface of U Pu Tc, self-irradiation damage in PuO<sub>2</sub>.

18. METAL PHYSICS \$366,000 01-01  
N. L. Peterson, W. K. Chen,  
E. S. Fisher, J. N. Mundy,  
S. J. Rothman, D. G. Westlake

Self-diffusion in Ag K Na Cr, impurity diffusion in Al U Zr Cu Li, diffusion in alloys and NaCl, effect of irradiation on diffusion in Ag, cation diffusion in NiO CoO FeO, defect structure and transport properties in (Fe,Co)O and (Fe,Ni)O systems, lattice dynamical diffusion theory, hydrogen effects in V Ti, elastic moduli in V and Ti alloys, pressure dependence of elastic moduli in Ti and Zr.

19. MECHANICAL PROPERTIES \$288,000 01-01  
U. F. Kocks, C. Y. Cheng,  
R. O. Scattergood

Dislocation theory, interaction of dislocations with obstacles, work hardening, theory of cyclic hardening, statistical theory of slip, cyclic hardening in Cu, structure of deformed Cu.

## ARGONNE NATIONAL LABORATORY

Materials Science Division -01- (Continued)

20. KINETIC STUDIES \$201,000 01-01  
 N. L. Peterson, L. M. Atlas,  
 J. W. Miller, F. V. Nolfi, Jr.

Theory of solid-state nucleation of voids and inert gas bubbles, growth kinetics of bubbles in Cu Au Al, dissolution of precipitates in Cu-Co alloys and interstitial solutes in Ag-Sn, isotope diffusion in Pb, channeling to determine position of solute atoms, FIM atom probe studies of precipitation, kinetics of point defects and dislocations in UO<sub>2</sub>.

21. ALLOY PROPERTIES \$651,000 01-02  
 J. B. Darby, Jr., A. T. Aldred,  
 F. Y. Fradin, L. L. Isaacs, G. S. Knapp,  
 D. J. Lam, F. M. Mueller, B. W. Veal, Jr.

Crystal structure and phase relationships of Np compounds, experimental and theoretical studies of crystal-field and exchange effects on actinide ions, NMR in Pu U Np phosphides and antimonides, low temperature specific heat studies of Np compounds, magnetization of Fe-V-Al and Fe-Cr-Al, Mössbauer studies on Fe-Cr alloys, weak band magnetism, low temperature specific heat on Sc<sub>3</sub>In Gd-Sc Pd-Gd Pd-Dy, NMR in transition metal alloys, optical properties of ZrZn<sub>2</sub> and HfZn<sub>2</sub>, electronic structure of ZrZn<sub>2</sub>.

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

Neutron magnetic scattering UAs-US USe-UP USe-UAs, neutron diffraction of Np-U-C Pu-Al<sub>2</sub>-UAl<sub>2</sub>, <sup>242</sup>Pu, <sup>242</sup>PuO<sub>2</sub>, polarized neutron diffraction of Tm Tb TmSb TbSb, study of magnetic electrons in Fe and U, diffraction studies of URhGe.

23. RADIATION EFFECTS \$491,000 01-03  
 T. H. Blewitt, E. E. Gruber,  
 A. C. Klank, B. A. Loomis, G. Kostorz

Effect of neutron irradiation on Nb, radiation hardening in Cu, vacancy escape from displacement cascades in Cu<sub>3</sub>Au, void as defect sinks in Al, saturation of electrical resistivity in BCC and HCP metals, low temperature x-ray diffraction, thermal migration of pores, interaction of irradiation defects with flux lines in Nb and Tc, flow stress in superconducting and normal Nb Nb-Mo Pb Pb-Tl Pb-Bi Pb-Sn Pb-Cd.

ARGONNE NATIONAL LABORATORY  
Materials Science Division -01- (Continued)

24. CHARGED PARTICLE IRRADIATION STUDIES      \$150,000      01-03  
 K. L. Merkle, M. R. Rühle

Studies of displacement cascade clusters by transmission electron microscopy, Xe and Kr on Au, dechanneling at twin boundaries, effect of channeling on defect production, defect migration and clustering, fission fragment damage, 300 keV heavy-ion accelerator, electron microscopy contrast calculations of defect clusters.

Solid State Sciences Division -02-  
 O. C. Simpson - Phone: 739-3141

25. MATERIALS PURIFICATION AND  
 CRYSTAL GROWTH      \$142,000      02-01  
 S. Susman, D. Hinks, F. Bellinger

Single crystals of KCN for neutron inelastic scattering, pure and doped LiCl single crystals, highly purified KCl, purification of KOH, growth of pure stoichiometric Er and Yb oxides by hollow cathode float zone method.

26. NEUTRON SCATTERING STUDIES      \$577,000      02-02  
 G. Felcher, D. L. Price,  
 J. M. Rowe, T. Worlton

Elastic and dynamical properties of solids and liquids, diffusion of H in V, calculation of multiple scattering effects in liquid A, computer simulation of liquid Na, inelastic scattering from KCN, neutron scattering from amorphous Ge Cr, phonon dispersion curves of Rb, crystal field effects by time-of-flight technique on PrN, lattice dynamics of CdTe, polarized neutron diffraction of Ni<sub>3</sub>Al Ni<sub>3</sub>Ga, study of the magnetic fields at the H nucleus in UH<sub>3</sub>, high pressure neutron diffraction of Ce.

27. DEFECTS IN NONMETALLIC CRYSTALS      \$253,000      02-02  
 P. Yuster, C. Delbecq,  
 D. Schoemaker, S. Susman

Investigations of alkali halides containing impurities, trapped electrons, holes, and other defects, luminescence spectra from KI:Sn<sup>2+</sup>, interstitial centers in substitutional Na<sup>+</sup> and Li<sup>+</sup> doped KCl crystals, EPR spectra and infrared spectra of various defect centers, trapped interstitial centers in KCl and KBr containing Ca<sup>++</sup>, Ba<sup>++</sup>, Sr<sup>++</sup> or Pb<sup>++</sup>, use of deuterium in isotope effects study of infrared experiments on H-containing species.

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

28. VERY LOW TEMPERATURE STUDIES \$142,000 02-02  
 J. Ketterson, Y. Eckstein,  
 M. Kuchnir, P. Roach

Properties of matter at very low temperature (down to 11 mK) with emphasis on liquid He, sound attenuation and velocity, phase separation properties, ion mobilities, interfacial properties, spin diffusion, temperature dependence of the drift velocity of vortex rings in dilute  $^3\text{He}$ - $^4\text{He}$  solutions, nuclear spin diffusion coefficient in  $^3\text{He}$  and  $^3\text{He}$ - $^4\text{He}$  solutions, effective mass of ions in pure  $^4\text{He}$  using cyclotron resonance, magnetic susceptibility of La-Ce alloys, superconducting transition temperature of noble metals, heat pulse propagation and the propagation of hypersonic sound generation by superconducting tunnel junctions.

29. SUPERCONDUCTIVITY AND LOW-TEMPERATURE CALORIMETRY \$212,000 02-02  
 H. Culbert, R. Huebener

Transport properties and magnetic structures in superconductors, superconducting order parameters, specific heats of superconductors, magneto-optical studies in superconducting Pb films, time variation of the order parameter in Al films, superconductivity in Ir-Cu thin sandwich films, strong coupling effects in Pb based superconducting alloys by specific heat measurements, effects of impurities on superconducting properties.

30. PHASE TRANSITIONS AND CRITICAL PHENOMENA \$249,000 02-02  
 L. Guttman, H. Kierstead, D. O'Reilly

Study of transitions in order-disorder systems, in liquid He, in ferroelectric and antiferroelectric materials, in liquid crystals, measurements of small angle x-ray scattering and neutron scattering, studies of PVT diagrams, ESR and NMR measurements, thermodynamic properties of He, PVT measurements on  $^3\text{He}$ - $^4\text{He}$  mixtures, critical x-ray opalescence from  $\text{Fe}_3\text{Al}$   $\text{AgAuZn}_2$ , Li proton and deuterium NMR in lithium ammonium tartate, pulsed NMR on simple polar liquids, spin-lattice relaxation times of N-14 and N-15 in liquid  $\text{N}_2$ .

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

31. ELECTRONIC AND MAGNETIC PROPERTIES                   \$282,000           02-02  
 B. Dunlap, G. M. Kalvius,  
 J. B. Ketterson, L. Windmiller

Mössbauer effect studies of magnetic properties and the electronic structure of transition metals with special emphasis on actinides, Fermi surface measurements of transition metals and alloys, hyperfine parameters in metals, alloys and compounds of U Np Am Eu Gd Yb Fe, amorphous magnetic materials, dHvA effect measurements in Pt Pd Rh Au, KKR calculations of band structure in Cu Pt, dHvA measurements on Nb U and UN.

32. ELECTRON SPIN RESONANCE AND  
 KINETIC STUDIES   \$252,000           02-02  
 S. Marshall, J. McMillan, B. Smaller

Studies of short-lived paramagnetic species in aqueous systems using EPR techniques, radiation damage in RNA and DNA molecules, electron paramagnetic resonance experiments to measure nuclear core polarization in various compounds of divalent Ag, paramagnetic defects in single crystal calcite and in ThO<sub>2</sub> and MgO.

33. SOLID STATE THEORY   \$373,000           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, temperature dependence of magnetic ordering in rare earth metals and alloys, many-body theory in magnetism, atomic motions in classical liquids, molecular dynamics, theory of neutron scattering measurements, theoretical research on the properties of liquid <sup>3</sup>He and <sup>4</sup>He, theoretical study of interatomic forces, optical and electronic properties of insulators, electron-phonon interactions, electronic structure of metals, theoretical study of superconductivity, localized magnet moments.

34. ENERGETIC PARTICLE INTERACTION                         \$222,000           02-03  
 J. Jackson, G. Montet, W. Primak

Deuteron irradiation of Pt, recovery stages of deformed Pt, stability of small vacancy clusters in Pt, void nucleation and transmission electron microscopy of void growth in Al, radiation damage in lithium niobate, vitreous silica, studies of graphite and NbSe<sub>2</sub>, optical properties of NbSe<sub>2</sub>.



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Materials Science Department -01-  
 D. H. Gurinsky - Phone: 924-6349

35. SUPERCONDUCTIVITY \$320,000 01-02  
 M. Strongin, M. Garber, D. Schweitzer,  
 J. Crow, O. Kammerer, H. Farrell, A. Saxena

Fundamental properties of superconductors with emphasis on cryogenically deposited thin films, critical temperatures, divergent fluctuations in superconducting films, surface and nucleation studies, mechanism of hysteresis in superconductors, low temperature studies of nuclear ordering in  $^3\text{He}$ , critical current capability and ac losses in high field superconductors, ultrahigh vacuum low temperature film evaporation techniques, LEED and Auger techniques for studying surfaces, surface studies of Nb and of  $\text{Nb}_3\text{Sn}$  films on Nb.

36. RELATIONSHIP BETWEEN PROPERTIES AND STRUCTURE \$150,000 01-02  
 J. Galligan, M. Suenaga

Low temperature plastic deformation in W, dislocation motion in the normal and superconducting state (Nb, Pb-In), magnetic flux lattice in type II superconductors, composite superconductors,  $\text{V}_3\text{Ga}$ , critical current and critical temperature in multifilamentary composites.

Department of Physics -02-  
 G. J. Dienes - Phone: 924-6633

NEUTRON SCATTERING STUDIES \$1,453,000 02-02

37. LATTICE DYNAMICS AND PHASE TRANSFORMATIONS  
 G. Shirane, J. D. Axe, J. Harada

Ferroelectric phase transformations in  $\text{BaTiO}_3$ ,  $\text{KNbO}_3$ ,  $\text{PbTiO}_3$ , interactions between overdamped optic modes and acoustic phonons in  $\text{BaTiO}_3$ , lattice dynamics of solidified rare gases (Ne, Kr), deuterated ice, dynamics of structural transformations in high temperature superconductors  $\text{V}_3\text{Si}$  and  $\text{Nb}_3\text{Sn}$ .

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

38. ONE-DIMENSIONAL ANTIFERROMAGNETS

J. Skalyo, Jr., G. Shirane,  
M. T. Hutchings

Neutron scattering studies of linear chain antiferromagnets,  
 $\text{CsMnCl}_3 \cdot 2\text{H}_2\text{O}$  and deuterated crystal,  $(\text{CD}_3)_4\text{NMnCl}_3$ .

39. SPIN WAVES AND CRITICAL SCATTERING

E. J. Samuelsen, R. Silbergliitt,  
G. Shirane, J. D. Axe, V. J. Minkiewicz,  
M. T. Hutchings, M. P. Schulhof

Neutron scattering measurements of spin waves in a nonmetallic  
ferromagnet  $\text{CrB}_3$ , critical magnetic scattering through the Neel  
temperature in  $\text{Cr MnP FeF}_2$ .

40. MAGNETIC STRUCTURES

D. E. Cox, V. J. Minkiewicz,  
G. Shirane, L. Passell

Studies of materials showing one-dimensional magnetic behavior,  
 $\text{RbNiCl}_3$ ,  $\text{RbFeCl}_3$ , isotropic Heisenberg ferromagnetic systems,  $\text{EuO}$   
and  $\text{EuS}$  prepared with  $\text{Eu-153}$ .

41. SLOW CHOPPER EXPERIMENTS

L. Passell

Studies of crystalline electric fields in metallic rare earth  
compounds using inelastic neutron scattering, Pr compounds,  $\text{CeP}$ ,  
 $\text{NdP}$ ,  $\text{HoP}$ ,  $\text{ErP}$ ,  $\text{TmP}$ ,  $\text{YbP}$ , Pr metal,  $\text{PrPb}_3$ ,  $\text{TmSb}$ , inelastic neutron  
scattering in liquid He in temperature range 1.2 to 4.2 K.

42. MATERIALS PREPARATION  
AND CRYSTAL GROWTH

D. E. Cox, J. J. Hurst,  
F. C. Merkert

Oxide single crystals by the top-seeded solution technique,  
 $\text{KTaO}_3$ , growth of ordered perovskite crystals,  $\text{Sr}_2\text{NiWO}_6$ , one-  
dimensional magnetic materials,  $\text{RbFeCl}_3$ ,  $\text{CsMnBr}_3$ .

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

43. COLD NEUTRON MODERATOR PROJECT  
 L. Passell, B. C. Frazer,  
 G. Shirane

To produce beams of very low energy neutrons from HFBR by means of a one liter liquid hydrogen target in the H-9 beam hole, target to act as a source for 3 separate beams.

44. THEORY \$109,000 02-02  
 M. Blume, R. Silbergliitt,  
 R. E. Watson, G. H. Vineyard

Quantum mechanical calculations of magnetic properties and interactions, spin waves, phonon and magnon distributions, phase transitions, conduction and valence electron effects in alloys, spin waves in layered magnetic systems, dynamics of one-dimensional Heisenberg magnets, magnetic susceptibility and spin-wave interactions in  $\text{CrBr}_3$ , perturbed angular correlations of nuclear gamma rays, energy band theory of transition metals.

45. SUPERCONDUCTIVITY \$97,000 02-02  
 M. Strongin, J. Crow, H. Farrell

Superconducting cavities and surfaces, fluctuations in superconducting films, preparation of ultrathin films at cryogenic temperatures, Bi films, elastic and inelastic scattering of low energy electrons from films of Ne Ar Kr and Xe, oxide structures on Nb surfaces.

ENERGETIC PARTICLE INTERACTIONS \$835,000 02-03

46. ORGANIC CRYSTALS  
 A. C. Damask, W. Whitten

Hall effect measurements on anthracene and naphthalene, triplet exciton dynamics in pyrene.

47. IONIC CRYSTALS  
 P. W. Levy, P. L. Mattern,  
 K. Lengweiler, M. Goldberg

Thermoluminescence studies of natural radiation induced defects in minerals, calcite, blue halite, yellow fluorite, LiF dosimeters, use of a high intensity Co-60 gamma ray facility, measurements on KCl and NaCl, role of strain on defect formation, radiation damage studies on ammonium perchlorate.

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

48. METALS AND ALLOYS

A. C. Damask, A. N. Goland,  
C. L. Snead, Jr.

Precipitation induced by neutron irradiation of Fe-C alloys, defect production and annealing in  $\text{Cu}_3\text{Au}$  using electron irradiation, internal friction measurements on electron-irradiated Pt, electron irradiation damage in Th, electron irradiation of superconducting metals.

49. DIFFRACTION STUDIES

D. T. Keating, J. Hastings,  
A. Nunes

Neutron diffraction study of amorphous Ge-Te, neutron diffraction study of the anharmonicity and temperature dependence of the forbidden (222) reflection in Si.

50. THEORY

A. N. Goland, D. T. Keating,  
G. J. Dienes, P. W. Levy

Diffraction from interstitial loops in a HCP crystal, molecular dynamic technique to simulation of atomic motion, molecular-ion calculations, defect calculations for the  $\text{NaN}_3$  lattice.

ILLINOIS, UNIVERSITY OF

Urbana, Illinois 61803

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

Metallurgy Department -01-

C. A. Wert - Phone: 333-1440

51. MECHANISMS OF SOLID STATE  
TRANSFORMATIONS \$37,000 01-02  
C. J. Altstetter

Studies of BCC refractory metals, chemical potential of oxygen in Nb using solid state electrolytic cells, solid solution limits in the V-N system, Nb-N system, electron and x-ray diffraction, mechanical behavior of V-N alloys.

52. ELECTRONIC STRUCTURE OF  
TRANSITION METAL ALLOYS \$74,000 01-02  
P. A. Beck

Low temperature specific heat, magnetization, Mössbauer studies of Fe-Al alloys, magnetic moments associated with 3d metal atoms in alloys, magnetic clusters in Au-Fe alloys Fe-Cr-Al alloys, Co-Re alloys.

53. POINT DEFECT-DISLOCATION  
INTERACTIONS \$112,000 01-02  
H. K. Birnbaum

Mechanical properties of BCC metals, low temperature microcreep, internal friction, Nb-H Fe-H Nb-N, diffusion and precipitation of H in Fe and Nb, dislocation-interstitial interactions in Nb, behavior of D in Nb, studies of H and D in Fe, effects of C and N on H diffusion in Fe, diffusion of He in Nb and in Ni.

54. PHASE TRANSFORMATIONS IN  
CRYSTALLINE SOLIDS \$29,000 01-02  
D. S. Lieberman

Diffusion of Fe and Co in FeCo, phase transformations in equiatomic NbRu and TaRu alloys, magnetic susceptibility measurements, x-ray structure studies.

ILLINOIS, UNIVERSITY OF  
Metallurgy Department -01- (Continued)

55. DISLOCATIONS AND SURFACE BARRIERS \$35,000 01-02  
 M. Metzger

Low strain behavior of copper-tungsten fiber composites, micro-strain measurements on coated and uncoated Cu crystals, dislocation etch pit techniques, transmission electron microscopy techniques.

56. DECOMPOSITION OF UNSTABLE SOLID SOLUTIONS \$23,000 01-02  
 J. Morral

Theoretical studies of precipitation and ordering kinetics in multi-component alloys, spinodal decomposition, zone formation, defect annealing.

57. STUDY OF ACOUSTIC EMISSION DURING THE PROPAGATION OF STRESS-CORROSION CRACKS 01-02

Project to begin in FY 1972, acoustic emission studies to characterize the fracture process in stress-corrosion cracking, Al alloys, stainless steels, Ti alloys, mechanism of the cracking process.

58. ANNEALING OF COLD-WORKED METALS \$24,000 01-02  
 B. G. Ricketts

Annealing textures, Al base alloys, effectiveness of solutes versus dispersed second phase in regulating the relative rates of recovery and recrystallization, TD-Ni.

59. NUCLEAR MAGNETIC RESONANCE STUDIES \$74,000 01-02  
 T. J. Rowland

Energy of vacancy migration in Al by pulsed magnetic resonance, electric field gradients at near neighbor sites in V alloys, precipitation in Cu-Be alloys, atomic diffusion in Al base alloys with Ge Si In Cu or Ag.

ILLINOIS, UNIVERSITY OF  
Metallurgy Department -01- (Continued)

60. SOLID STATE PHASE TRANSFORMATIONS  
 AND THIN FILMS \$104,000 01-02  
 C. M. Wayman

Nucleation and growth of FCC films on hexagonal substrates in ultra high vacuum, nucleation and growth of BCC metals on NaCl, relationship between martensitic and bainitic transformations in Cu-Zn alloys, thermoelectric properties of thin films, nucleation of phase transformations in thin films, sputter deposition of thin films.

61. THE STUDY OF THE NATURE OF  
 SOLID SOLUTIONS OF METALS \$47,000 01-02  
 C. A. Wert

Interstitials C N O H in V and Nb, diffusion rates, precipitation of metal-interstitial compounds and ordering of interstitials, internal friction electron microscopy, magnetic and electrical properties of liquid alloys of Cu Fe Ga Ge with Mn V Fe Co, kinetics of liquid-phase sintering of Fe powder, study of carbides in Nb, dislocation characteristics of the Nb-NbH two phase mixture.

Physics Department -02-  
 R. J. Maurer - Phone: 333-1370

62. USE OF VERY HIGH PRESSURE TO  
 INVESTIGATE THE STRUCTURE  
 OF MATTER \$95,000 02-02  
 H. G. Drickamer

Mössbauer resonance studies of Fe to 250 Kb, optical absorption and photochemical studies of both electronic and molecular excitations for wavelengths to 13.0 microns at 160 Kb, transition metals, lanthanide and actinide compounds, irreversible processes in aromatic compounds and complexes, x-ray diffraction to 400 Kb, electrical resistance to 500 Kb, behavior of Fe in biological prototype molecules, high pressure chemistry of Cu.

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

63. ANHARMONIC EFFECT IN SOLIDS \$74,000 02-02  
 A. V. Granato

Equation of state of solids, interatomic potentials, determination of anharmonic effects, defect properties of crystals, measurement of second and third order elastic constants by determination of sound velocities under hydrostatic and uniaxial stress, NaCl CdS Al Pb MnF<sub>2</sub>.

64. DEFECT AND ELECTRONIC PROPERTIES OF SOLIDS \$131,000 02-02  
 D. Lazarus

Theoretical studies of the nature of the diffusional jump process, experimental studies of the effect of pressure to 10 Kb on defect formation and motion in metals and ionic solids, effect of pressure on electronic thermal transport properties of metals and alloys at low temperatures, MnSb-Cr alloys, self-diffusion in Ti, Fermi surface of Al.

65. PROPERTIES OF NOBLE GAS CRYSTALS \$151,000 02-02  
 R. O. Simmons

Theories of lattice dynamics and the nature of atomic interactions, noble gas crystals, x-ray, ultrasonic and laser light-scattering methods, second order elastic constants of Ne, thermal vacancy concentrations in solid Ar, thermal excitation of structural defects in BCC <sup>3</sup>He.

66. NUCLEAR MAGNETIC RESONANCE IN SOLIDS \$96,000 02-02  
 C. P. Slichter

Knight shift and quadrupole coupling of atoms near magnetic impurities in Cu, nuclear double resonance of Na atoms near Ag impurities in NaCl, use of alternating electric fields to induce spin transitions in atoms not at centers of inversion symmetry.

67. PHYSICS OF REFRACTORY MATERIALS \$94,000 02-02  
 W. S. Williams

Thermal conductivity at low temperatures of transition metal carbides, order-disorder transition in VC, dislocation velocities in carbides, internal friction and x-ray measurements, high temperature internal friction on TiC ZrC NbC TaC.



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

68. SOLID STATE PHYSICS; ENERGETIC  
PARTICLE INTERACTION AND SUMMARY \$140,000 02-03  
J. S. Koehler

Anomalous x-ray transmission in Cu, electron microscopy and channeling, Ag Au, geometrical structure of interstitials in Si and Ge, channeling studies of 1 MeV protons on Ag single crystals, electron scattering by defects in Au single crystals, heavy ion channeling into Au Si Ge, high temperature electron damage in Au.

## LAWRENCE RADIATION 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

69. KINETICS OF DISLOCATION DYNAMICS                      \$108,000              01-01  
J. E. Dorn

Theory and experiments related to dislocation mechanics, strain rates from  $10^{-7}$ /sec to  $10^5$ /sec, high temperature creep of Al-Mg alloy, low temperature behavior of BCC metals (Mo, Mo-Re), mechanical behavior of  $\text{Cu}_3\text{Au}$ , superplasticity, solute atom interactions with dislocations.

70. FUNDAMENTAL ASPECTS OF                                      \$100,000              01-01  
STRENGTH AND TOUGHNESS  
E. R. Parker

Electron fractography, scanning electron microscopy, effects of second phase particles on strength and toughness, strength-toughness relationships in eutectoid steels, dislocation configurations around arrested cracks in Si, stress-corrosion cracking in Ti and Al alloys.

71. RELATION BETWEEN MICROSTRUCTURE                      \$180,000              01-01  
AND PROPERTIES: ELECTRON  
MICROSCOPY AND DIFFRACTION  
G. Thomas

Electron microscopy with 650 kV high voltage electron microscope, field ion microscopy, alloy steels, spinodal and ordering transformations, oxide systems, semiconductors, biological materials.

72. MICROSTRUCTURE AND BEHAVIOR OF                      \$129,000              01-01  
CERAMIC MATERIALS: GLASS AND  
CERAMIC-METAL SYSTEMS  
J. A. Pask

Electrochemical reactions at ceramic-metal interfaces, diffusion experiments to determine diffusivities and mechanism of mullite formation, kinetics of liquid phase sintering and grain growth in ceramics, dissolution of oxides in  $\text{N}_2\text{Si}_2\text{O}_5$  glasses, creep in LiF, stress-strain and creep in two-phase systems (MgO), electron microprobe.

LAWRENCE RADIATION LABORATORY  
Inorganic Materials Research Division (Continued)

73. CRYSTAL IMPERFECTIONS \$105,000 01-01  
 J. Washburn

Slip and dislocation interactions during plastic deformation (Cu), atom probe field ion microscopy, Ni<sub>4</sub>W, field ion microscopy of radiation damage, dislocation climb, collapse of tetrahedra and climb of triangular Frank loops, pipe diffusion and conservative climb of dislocations in MgO, heavy ion bombardment of Nb foils.

74. RELATION OF MICROSTRUCTURE .  
 TO PROPERTIES OF CERAMICS \$130,000 01-01  
 R. M. Fulrath

Sintering of Pb zirconate titanate, monatomic gas solution in glass, fracture in composites, scanning electron microscopy (SEM), diffusion and solubility of He and H<sub>2</sub> in fused silica, processing of ferro-magnetic and ferroelectric ceramics, direct observations of sintering with the SEM.

75. COMPOSITE MATERIALS AND THEIR  
 ELECTRICAL AND MAGNETIC PROPERTIES \$55,000 01-01  
 R. H. Bragg

X-ray characterization of glassy carbon, small angle scattering, low temperature transport properties, conductivity and Hall effect in Be, low temperature thermal expansion coefficients of graphite, interfacial phenomena in graphite-Al composites, low temperature thermal expansion of BN, composite materials using controlled eutectic solidification.

76. HIGH STRENGTH MATERIALS \$130,000 01-01  
 V. F. Zackay

Strengthening role of chemistry, processing, stacking fault energy, austenite stability and resulting morphology of strain induced martensite in TRIP steels, effect of C N H on the promotion of embrittlement, fatigue properties, high strength alloys of Fe-Ni-Ti and Fe-Ni-Mn-Ti, corrosion and stress corrosion properties.

LAWRENCE RADIATION LABORATORY  
Inorganic Materials Research Division (Continued)

77. SUPERCONDUCTIVITY EFFECTS--  
HIGH FIELD SUPERCONDUCTIVITY \$173,000 01-02  
L. Brewer, E. R. Parker,  
V. F. Zackay, R. Hammond

Synthesis of superconductors by co-deposition, electron beam evaporator system, Pb Sn Al Nb V Ta Mo, epitaxial thin films of A-15 compounds; amorphous transition metals and alloys,  $V_3Al$ .

78. HIGH TEMPERATURE REACTIONS \$115,000 01-02  
A. W. Searcy

Experimental and theoretical study of solid-gas interface reactions, effusion measurements, mass spectrometry study of gaseous species in the Re-Re<sub>2</sub>O<sub>7</sub> system, crystallographic dependence of vaporization rates of ZnS, stability of (NaCl)<sub>3</sub> and (LaF<sub>3</sub>)<sub>2</sub> gas, decomposition of CaCO<sub>3</sub> single crystals.

79. THERMODYNAMICS OF METAL SYSTEMS \$108,000 01-02  
R. Hultgren

Low temperature heat capacities of InPb Mg<sub>3</sub>Sb<sub>2</sub> AuCd Cu<sub>3</sub>Au, critical evaluation of thermodynamic data for metallic systems, vapor pressure studies of Pb-Pt alloys, high temperature heat content of sodium nitrate.

80. ELECTRICAL PROPERTIES OF METALLIC  
CONDUCTORS AND SUPERCONDUCTORS \$30,000 02-02  
M. Merriam

Superconducting power transmission, non-precious metal electrodes for multilayer barium titanate capacitors, composite Nb<sub>3</sub>Sn in Pb matrix, use of Ag in capacitor applications.

81. THEORETICAL SOLID STATE PHYSICS \$18,000 02-02  
M. L. Cohen

Empirical pseudopotential method for calculating band structures, calculation of superconducting transition temperatures, Fermi surface calculations in Si Ge GaS InSb CdTe  $\alpha$ Sn, dilution refrigerator for low temperature measurements, optical constants for Cu, optical properties of Al Ag Au.



LAWRENCE RADIATION LABORATORY  
Inorganic Materials Research Division (Continued)

86. RESEARCH ON SUPERCONDUCTING  
JUNCTIONS AND DEVICES \$95,000 02-02  
J. Clarke

Theory of current-voltage characteristics of superconducting tunnel junctions and weak links, superconducting transformer and transistor devices, Josephson junctions, Sn-Bi-Sn, resistance of superconducting-normal metal-superconducting (SNS) junctions at ultra low temperatures, Mg Cu Ag Au, dilution refrigerator, study of magnetic impurities in metals, magnetic focusing in metals, use of SNS junctions as bolometers in the far infrared.

MOUND LABORATORY

Monsanto Research Corporation

P. O. Box 32

Miamisburg, Ohio 45342

L. J. Wittenberg - Phone: Area Code 513 866-7444 x7286

87. LIQUID ACTINIDE METALS RESEARCH \$100,000 01-01  
L. J. Wittenberg, R. DeWitt

Thermal conductivity by thermal diffusivity techniques for Pu phases, viscosities of liquid Pu U Np, solid-liquid transformation in the actinides, density and electrical resistivity of liquid actinides, thermal conductivity of Ce solid and liquid.

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

88. FUNDAMENTAL AND PHYSICAL CERAMIC STUDIES \$175,000 01-01  
 J. Brynestad, C. S. Yust

Study of the basic properties of ceramic materials with emphasis on defects, high temperature properties and irradiation effects, deformation of hyperstoichiometric  $UO_2$  single crystals, diffusion along dislocations in  $UO_2$ , neutron radiation damage in  $B_xC_y$ , effects of Zr cation on deformation of  $UO_2$ , deformation studies of  $CaF_2$  doped with Y.

89. PHYSICAL PROPERTY RESEARCH \$216,000 01-01  
 D. L. McElroy, T. G. Kollie,  
 R. K. Williams, J. P. Moore

Heat transport and thermophysical measurements on solids from 1.2 to 2600 K, thermal conductivity, electrical resistivity, thermopower, specific heat capacity, thermal expansion, Ta and Ta-W alloys, Mo and Mo alloys, W Al UN ThN (Th,U)N, zone melting in  $N_2$  process, Ni  $Ni_3Mn$ , graphite, Re Na V Nb  $UO_2$ , 2000 K radial heat flow apparatus.

90. METALLURGY OF SUPERCONDUCTING MATERIALS \$175,000 01-01  
 C. C. Koch, D. M. Kroeger

Precipitation and superconductivity in Nb-37% Hf, Nb-Ir and Mo-Re alloys, superconducting transition temperatures and low temperature specific heat, Tc-Mo, correlation of dislocation distribution and superconducting critical current density in Nb-10% Ti, study of the nature of the ac susceptibility method for measuring  $J_c$ , influence of interstitial atoms on superconducting properties (Nb-O), Tc-Ti, preparation of pure Tc single crystals.

## OAK RIDGE NATIONAL LABORATORY

Metals and Ceramics Division -01- (Continued)

91. DEFORMATION OF CRYSTALLINE SOLIDS                    \$131,000            01-01  
 R. O. Williams, R. W. Carpenter,  
 M. H. Yoo

Mechanism of precipitation in nearly equiatomic Nb-Hf alloys, elastic fields of nonrectilinear dislocation configurations, tensile deformation of Re single crystals, computer modeling of strain effects in solid solutions, theoretical studies of the ordering of voids.

92. FUNDAMENTAL PHYSICAL METALLURGY                    \$131,000            01-01  
 R. A. Vandermeer, J. C. Ogle,  
 W. A. Coghlan, A. Wolfenden,  
 J. O. Stiegler, K. Farrell

Deformation and annealing, grain growth, texture differences among various BCC metals and alloys, Ti-Nb and U-Nb-Zr cold rolled texture, analysis of Auger electron spectra, deformation processes using computer simulation techniques, electron fractography to study the development of creep cavities in W, stored energy measurements in deformed Cu-Cu<sub>3</sub>Au, phase transformations in U alloys.

93. SURFACE PHENOMENA                                        \$175,000            01-01  
 J. V. Cathcart, R. E. Pawel,  
 R. E. Clausing, J. E. Epperson

Oxidation mechanisms U and Ta based alloys, Auger electron spectroscopy and electron-bombardment-induced desorption, structure and properties of surfaces, studies of diffusion in elastically stressed specimens.

94. FUNDAMENTAL RESEARCH IN  
 X-RAY DIFFRACTION    \$183,000            01-02  
 B. S. Borie, R. W. Hendricks,  
 C. J. Sparks, H. L. Yakel

X-ray diffraction studies of metastable transformation products in gamma-quenched U alloys, structure of B<sub>4</sub>C, small angle x-ray scattering investigation of radiation damage in Al, radiation damage in graphite, diffuse scattering from Mo-Ta alloys, double-Bragg scattering studies of pure metals and Zr-Nb, structure of Nb-V alloys, diffuse scattering from solid solutions of CaF<sub>2</sub>:YF<sub>3</sub>.



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

95. THEORETICAL RESEARCH \$137,000 01-02  
 J. S. Faulkner, G. S. Painter,  
 G. M. Stocks

Applications of the coherent potential approximation (CPA) to calculating electronic states of disordered Cu-Ni alloys, extension of CPA method to liquid metals, KKR band calculations, discrete variational method (DVM) applied to calculate density of states and optical properties of diamond and SiC, development of a hybrid technique KKR-DVM to be tested on Li, theory of total energy phenomena such as binding energy, phase stability and energy of defects.

96. DIFFUSION IN SOLIDS \$183,000 01-02  
 T. S. Lundy

Cation self diffusion coefficients in TiO<sub>2</sub>, Ti diffusion in TiO<sub>x</sub>, short-circuiting diffusion in UO<sub>2</sub>, diffusion of Fe in stainless steel, redistribution of elements in temperature gradients in NaCl and KCl, diffusion in Nb Ta W at high temperatures and pressures.

97. CRYSTAL SPECTROSCOPY \$92,000 01-02  
 G. P. Smith

Development and use of optical methods to study the geometrical structures, electronic states and electron-lattice coupling for defects formed by transition-metal impurity ions in crystals, piezospectroscopy, MgO.

98. RADIATION DAMAGE \$160,000 01-03  
 J. O. Stiegler, K. Farrell, A. Wolfenden,  
 R. W. Hendricks, B.T.M. Loh, H. L. Yakel,  
 R. A. Vandermeer, R. W. Carpenter,  
 K.H.G. Ashbee, J. E. Epperson

Void formation in irradiated metals, high voltage electron microscopy (650 kV), Al and Al alloys, effects of gaseous impurities, grain boundary effects, annealing of voids, small angle x-ray scattering, neutron irradiations in HFIR, B<sub>4</sub>C, graphite, mechanical properties of irradiated Al, mechanisms for void formation.

## OAK RIDGE NATIONAL LABORATORY

Solid State Division -02-

D. S. Billington - Phone: 483-6713

99. RESEARCH AND DEVELOPMENT

ON PURE MATERIALS

\$680,000

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

Research on purification, crystal growth and characterization of research-quality specimens, research materials information center (RMIC), Ge for detector use, MgO V Nb  $^{154}\text{Sm}$   $^{163}\text{Dy}$   $^{170}\text{Er}$ , Re single crystals, Nb-Mo Nb-Zr Nb-V, Pd foils, PbS, Co-doped lithium ferrite,  $\text{UO}_2$ -W MgO- $\text{UO}_2$   $\text{Mg}_2\text{SiO}_4$   $\text{NpO}_2$   $\text{ThO}_2$ , graphite,  $\text{Nb}_3\text{Sn}$ , Nb superconducting cavities,  $\text{PuO}_2$ .

100. SUPERCONDUCTIVITY

\$100,000

02-02

S. T. Sekula, R. H. Kernohan

Critical current and low frequency behavior of fast neutron irradiated Nb, Nb-Zr, magnetic fluxoid-defect interactions, V Nb-Mo alloys, Ga Sn Re.

101. NEUTRON SPECTROMETRY

\$440,000

02-02

M. K. Wilkinson, H. G. Smith,  
 H. A. Mook, R. M. Nicklow,  
 N. Wakabayashi, A.A.Z. Ahmad,  
 B. N. Brockhouse, R. H. Scherm

Inelastic neutron scattering from magnetic and non-magnetic materials, critical scattering near chemical and magnetic phase transitions, polarized neutron scattering, small angle scattering with long wavelength neutrons, TaC HfC  $\text{TiO}_2$   $\text{Mg}_2\text{Pb}$  Cu Ge KCl CsCl, lattice dynamics of heavy rare earths (Dy, Er, Ho), spin waves in Fe and Cr,  $\text{FeCO}_3$   $\text{NH}_4\text{Cl}$  Y-Tb, magnetically pulsed time-of-flight spectrometer.

102. SPIN RESONANCE

\$100,000

02-02

M. M. Abraham, J. L. Kolopus

ESR studies of strength and nature of the local crystal field of paramagnetic defects, irradiated MgO  $\text{MgF}_2$  CaO  $\text{KMgF}_3$   $\text{ThO}_2$ , Pu and Am in  $\text{SrCl}_2$ .

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

103. NEUTRON DIFFRACTION \$380,000 02-02  
 W. C. Koehler, J. W. Cable,  
 H. R. Child, R. M. Moon, Q. H. Khan

Magnetic properties, polarized neutron spectrometry, form factor determination, magnetic moment distribution, spin wave scattering, critical scattering, paramagnetic scattering, nuclear polarization, Ni-Mn Ni-Pd, Co alloys, Fe-Co  $^{160}\text{Gd}$   $^{154}\text{Sm}$  Th-Dy Th-Ho  $\text{Au}_2\text{Mn}$  CeSb  $\text{Ni}_3\text{Al}$   $\text{V}_2\text{O}_3$   $\text{CeAl}_2$   $\text{CeAl}_3$ , intra rare earth alloys (Ho-Dy, Er-Dy), long wavelength neutron beam (4A).

104. DEFECT STRUCTURES IN NONMETALS \$333,000 02-02  
 E. Sonder, Y. Chen, B. Henderson,  
 J. C. Pigg, L. C. Templeton,  
 O. E. Schow, W. E. Vehse

Defects in MgO and CaO by doping and irradiation, optical absorption, alkali halides (NaCl, KCl), stored energy, low temperature electron irradiation induced defects in MgO, ESR in BeO,  $\text{KMgF}_3$ - $\text{KMnF}_3$  mixed crystals,  $\text{RbMgF}_3$ .

105. X-RAY DIFFRACTION AND ELECTRON MICROSCOPY \$190,000 02-03  
 T. S. Noggle, S. M. Ohr, B. Nøst,  
 H. F. Wenzl, B. C. Larson, F. A. Sherrill

Studies of defects in nearly perfect crystals, x-ray anomalous transmission and topography measurements, Cu Al Li precipitation in Ge, in situ electron irradiated graphite, generation and motion of dislocations, grown-in, radiation induced and strain induced defects, charged particle irradiations in Cu, electron microscopy in-situ damage in Cu Al.

106. SURFACE STUDIES ON METALS \$225,000 02-03  
 F. W. Young, Jr., L. H. Jenkins,  
 U. Bertocci, M. F. Chung

LEED studies of oriented Cu and Si surfaces, characterization of defects formed by electrolytic deposition on Cu single crystals, Auger spectroscopy, kinetics of electrodeposition process, x-ray topographic study of effects of surface films on dislocations in Cu.

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

107. THEORY AND COMPUTATIONS \$450,000 02-03  
 D. K. Holmes, R. F. Wood,  
 M. T. Robinson, G. Leibfried,  
 J. H. Barrett, J. F. Cooke,  
 H. L. Davis, B. N. Ganguly,  
 M. E. Mostoller, O. S. Oen

Radiation damage in metals, displacement cascades, channeling of energetic particles, interatomic potentials in solids, lattice dynamics, electronic structure of solids, magnetism, spin waves in rare earth metals, band structure calculations for actinide compounds, annealing of radiation damage, pressure dependence of the superconducting transition temperature in A-15 compounds, Fermi surface of Cu, diffusion of point defects, band structure calculation for HfC and TaC, optical spectra of point defects in insulators.

108. RADIATION EFFECTS AND ANELASTICITY IN METALS \$483,000 02-03  
 R. R. Coltman, V. K. Pare,  
 H. D. Guberman, C. E. Klabunde,  
 A. L. Southern, J. K. Redman,  
 J. L. Hemmerich

Thermal neutron irradiation effects from 3° to 450°K, Cu Au W Co Re Mo Al Pt, post-irradiation annealing studies from 3° to 1000°K, electrical resistance, internal friction, elastic modulus, defect migration, recombination and interaction with dislocations.

109. ION BOMBARDMENT \$84,000 02-03  
 B. R. Appleton

Heavy ion bombardment of ZnO, channeling and blocking studies in thin Au and Ag crystals, ion implantation, energy loss and damage processes in solids, 2.5 MeV ion accelerator, radiation damage using H and He beams.

PACIFIC NORTHWEST LABORATORY  
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 Phone: Area Code 509 942-1111

110. TRANSURANIUM PHYSICAL  
 METALLURGY RESEARCH \$212,000 01-01  
 R. D. Nelson, S. D. Dahlgren,  
 M. D. Merz, R. P. Allen

Phase transformations, kinetics of phase transformations, crystallographic relationships, plasticity of alpha-Pu and beta-Pu, recrystallization of alpha-Pu, superplasticity in alpha-Pu and beta-Pu, anisotropic properties, creep of Pu, properties of sputtered Pu and stainless steel, self-irradiation damage in Pu at low temperatures, electron microscopy, transformation studies in Pu-Am system.

111. SPUTTER-DEPOSITION OF  
 SUPERCONDUCTORS (25,000) 01-01  
 R. D. Nelson

To start in FY 72, cathodic sputtering as a method of preparing superconductors,  $Nb_3Sn$ ,  $Nb_3(Al_{0.75}Ge_{0.25})$ , radiation damage resistance of sputtered metals, mechanical properties of sputter deposits.

112. TRANSURANIUM CERAMICS RESEARCH \$65,000 01-02  
 T. D. Chikalla, R. Turcotte

Oxygen decomposition measurements to evaluate stability of  $BkO_{2-x}$  and  $CmO_{2-x}$ , thermodynamic behavior of nonstoichiometric transuranium oxides, self-irradiation damage in oxides, high temperature x-ray diffraction, dissociation behavior in Am-O system, high sensitivity capacitance manometer system.

113. RADIATION EFFECTS ON METALS \$245,000 01-03  
 G. L. Kulcinski, J. L. Brimhall,  
 H. E. Kissinger

Neutron and heavy ion damage at high temperatures in metals, Mo Re Ta Ni Pt Nb, influence of temperature, fluence and flux on void formation, transmission electron microscopy, x-ray diffraction, electrical resistivity, precision length changes of single crystals, mechanical properties, simultaneous He and heavy ion bombardment, effect of tensile stress on void formation, effect of voids on yield strength and ductility.

PUERTO RICO NUCLEAR CENTER  
Caparra Heights Station  
San Juan, Puerto Rico 00935  
Phone: Area Code 809 767-0350

114. NEUTRON DIFFRACTION \$93,000 02-02  
M. I. Kay

Magnetic structures of inorganic salts, role of hydrogen in various compounds,  $\text{Sr}_2\text{RuD}_6$ , magnetic structure of  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ ,  $\text{NaNO}_2$ ,  $\text{Bi}_2\text{WO}_6$ ,  $\text{Bi}_4\text{Ti}_3\text{O}_{12}$ , copper formate  $\cdot 4\text{H}_2\text{O}$ .

115. STUDY OF RADIATION DAMAGE IN ORGANIC CRYSTALS USING ELECTRICAL CONDUCTIVITY AND OPTICAL PROPERTIES \$20,900 02-03  
Z. S. Weisz

Effects of radiation on electrical conductivity and optical properties of anthracene and phenanthrene crystals, annealing of irradiated crystals, ESR

116. RADIATION DAMAGE, DEFECT FORMATION AND STRUCTURE, AND ALKALI EFFECTS IN SOLID RARE GASES \$27,000 02-03  
B. Cruz

Defects and impurity effects in rare gas solids, stored energy in solid Ar and Kr, ESR studies of paramagnetic defects and substitutional alkali atoms, optical properties of irradiated crystals.



## 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 - Department of Physics (18 mos.)  
and Mathematics

Effects of impurities on theoretical models, K, impurity contributions to the Fermi surface, energy gap anisotropy, density of states, electron-impurity scattering cross sections.

## ARIZONA, UNIVERSITY OF

202. IMPURITY DIFFUSION IN SOLIDS \$84,942 02-02  
C. T. Tomizuka - Department of Physics

Application of high pressure techniques to diffusion determination of activation volumes, conductivity measurements, solid He, Al, Zn, In.

## BOSTON UNIVERSITY

203. COINCIDENCE-MÖSSBAUER STUDIES OF  
SOLID STATE PHENOMENA \$26,333 02-02  
G. R. Hoy - Department of Physics

Applications of coincidence-Mössbauer spectroscopy to the study of after-effects, localized modes of vibration, and various relaxation processes in solids,  $\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$ ,  $\text{CoCl}_2 \cdot 4\text{H}_2\text{O}$ .

## BRANDEIS UNIVERSITY

204. EXPERIMENTAL STUDIES OF CRITICAL  
POINT BEHAVIOR IN MAGNETICALLY ORDERED  
SOLIDS USING NUCLEAR GAMMA-RAY SPECTRO-  
SCOPY, AND RELATED EXPERIMENTS \$30,558 02-02  
C. Hohenemser - Department of Physics

Time dependent perturbed angular correlation studies of magnetically ordered systems, obtain the critical exponents and to fit the entire equation of state using experimental values of the hyperfine field, study impurity atom magnetic couplings.

## BRANDEIS UNIVERSITY (Continued)

205. LOW TEMPERATURE PROPERTIES OF  
LIQUID AND SOLID HELIUM \$28,000 02-02  
H. D. Cohen - Department of Physics

Magnetic susceptibility of pure solid  $^3\text{He}$  to measure exchange energy, light scattering on liquid  $^3\text{He}$  to investigate the excitation spectrum, effects of  $^4\text{He}$  impurities, normal sound to second sound transition in liquid  $^3\text{He}$ .

## BRIGHAM YOUNG UNIVERSITY

206. THERMODYNAMIC INVESTIGATION OF  
ALKALI METAL MIXTURES \$30,941 01-02  
J. B. Ott and J. R. Goates - Department  
of Chemistry

Thermodynamic studies of alkali metal mixtures of Na, K, Rb and Cs, solid-liquid phase diagrams for K-Rb Rb-Cs Na-K-Rb Na-K-Cs, high pressure phase studies on Na K Rb Cs Na-K, x-ray diffraction, electrochemical cell measurements.

## BROWN UNIVERSITY

207. A COMBINED MACROSCOPIC AND MICRO-  
SCOPIC APPROACH TO THE FRACTURE  
OF METALS \$61,500 01-01  
J. Gurland - Division of Engineering

Role of microstructure in fracture of steels, effects of microstructure, temperature and crack velocity on dynamic fracture toughness, prediction of fracture initiation from macroscopic plasticity theory incorporating microscale effects, creep and creep rupture.

## CALIFORNIA INSTITUTE OF TECHNOLOGY

208. DISLOCATION MOBILITY AND DENSITY  
IN METALLIC CRYSTALS \$71,247 01-01  
T. Vreeland, Jr. - Division of  
Engineering and Applied Science

Interactions of dislocations with crystal defects, direct observation of dislocations, stress induced motion of dislocations in single crystal Cu Ag Zn Mo Nb Fe.

## CALIFORNIA INSTITUTE OF TECHNOLOGY (Continued)

209. STUDIES OF ALLOY STRUCTURE AND PROPERTIES \$230,000 01-02  
P. Duwez - 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 and electron diffraction and microscopy, magnetic and superconducting materials, kinetics of transformation.

## CALIFORNIA, UNIVERSITY OF

210. PARTICLE SIZE DISTRIBUTION EFFECTS IN PRECIPITATION HARDENING \$38,000 01-01  
A. J. Ardell - Materials Department, Los Angeles

Particle size distribution effects on mechanical behavior of Ni base alloys hardened by gamma prime precipitate, precipitate coarsening, bimodal distributions, Ni-Al Ni-Cr-Al.

211. ELECTRIC AND MAGNETIC PROPERTIES OF TRANSITION METALS AND THEIR COMPOUNDS \$61,200 02-02  
A. W. Lawson - Department of Physics, Riverside

Magnetic properties of rare earth salts, spin wave resonance in Eu chalcogenides, magnetic susceptibility in EuSe EuTe SmTe, magnetic anisotropy in GdN, ferromagnetic resonance in DySb, antiferromagnetic resonance in CrCl<sub>3</sub>, magnetostriction in Eu chalcogenides.

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

Sputtering technique applied to deposition of new materials, superconducting materials Nb-Al-Ge, magnetic materials ZrZn<sub>2</sub>.

## CALIFORNIA, UNIVERSITY OF (Continued)

213. RESEARCH ON THE PROPERTIES OF  
MATERIALS AT VERY LOW TEMPERATURES \$148,226 02-02  
J. C. Wheatley - Department of Physics,  
San Diego

Adiabatic compression of  $^3\text{He}$ , properties of liquid  $^3\text{He}$  and dilute solutions of  $^3\text{He}$  in  $^4\text{He}$ , anomalous thermal contact between pure liquid  $^3\text{He}$  and magnetic bodies, properties of alloys and other weakly magnetic systems, temperatures down to millidegree temperatures using dilution refrigerators.

## CARNEGIE-MELLON UNIVERSITY

214. OPTICAL AND MICROWAVE SPECTROSCOPY OF  
Np AND Co IN SCHEELITES AND OTHER  
CRYSTALLINE ENVIRONMENTS \$34,000 02-02  
J. O. Artman - Departments of Physics  
and Electrical Engineering

Experimental and theoretical work on  $\text{CaF}_2:\text{Np}^{237}$  system, Zeeman splitting using a superconducting magnet-cryostat assembly, conversion of  $\text{Np}^{4+}$  to  $\text{Np}^{3+}$  ions by x-irradiation and thermal and electrolytic reduction, fluorescence, free-ion and crystal field parameters,  $\text{LiYF}_4:\text{Np}^{237}$ .

## CASE WESTERN RESERVE UNIVERSITY

215. MOTION OF IONS IN SOLID HELIUM \$28,042 02-02  
A. J. Dahm - Department of Physics

Mobility of positive and negative charge carriers in solid He, time of flight technique for negative carrier with pulsed tunnel diode electron source, positive ion mobility from space charge limited characteristics of diode, lifetime of ortho-positronium.

216. DISLOCATION-SOLUTE ATOM INTER-  
ACTIONS IN ALLOYS \$39,000 01-01  
R. Gibala - Division of Metallurgy  
and Materials Science

Strain aging and interstitial-defect interaction in austenitic steels by anelastic techniques, dislocation-solute atom interaction in Nb and Nb alloys by dislocation damping, interstitial and substitutional solute hardening and softening in Nb, anelasticity of BCC solid solutions.

## CASE WESTERN RESERVE UNIVERSITY (Continued)

217. KINETICS OF PHASE TRANSFORMATIONS  
 IN ZIRCONIUM, HAFNIUM AND  
 TITANIUM ALLOYS \$23,340 01-01  
 R. F. Hehemann - Division of Metallurgy  
 and Materials Science

Martensitic transformations and pre-martensitic atomic movements,  
 Ti-Ni, x-ray diffraction, in-situ transmission electron microscopy.

218. SOLID STATE PHYSICS \$79,000 02-02  
 R. W. Hoffman - Department of Physics

Torque magnetometer measurements on thin film Ni, internal field by  
 Mössbauer measurements in Ni, equation of state of solids and  
 dielectric constants of ionic crystals, theory of disordered solids,  
 effects of magnetic fields on the energy levels of Bloch electrons  
 and transport properties, relativistic KKR band structure calcula-  
 tions of HCP metals.

219. EXPERIMENTS IN HIGH VOLTAGE  
 ELECTRON MICROSCOPY \$53,915 01-03  
 T. E. Mitchell - Division of Metallurgy  
 and Materials Science

Use of high voltage (650 kV) electron microscopy in selected area  
 diffraction and in-situ radiation damage studies, study of small  
 particles in thoriated Ni W filament wire interstitial precipitates  
 in Ta and Nb, amorphous structure of glasses, radiation damage in Al.

## CHICAGO, UNIVERSITY OF

220. INTERACTIONS ON METALLIC SURFACES \$50,086 02-02  
 R. Gomer - Department of Chemistry

Adsorption on single crystal planes of W, mass spectrometric study  
 of electron impact desorption of CO and H, energy distribution of  
 field emitted electrons in the presence of adsorbates, Ar imaging  
 in field ion microscopy study of adsorption.

## CHICAGO, UNIVERSITY OF (Continued)

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

Optic phonon damping processes in  $\text{RbClO}_3$  and  $\text{TlClO}_3$  using  $\text{CO}_2$  laser radiation, spontaneous and resonance Raman effect in amorphous solids, phonon bound states and resonances in Si and Ge using YAG laser with interchangeable  $\text{Nd}^{3+}$  and  $\text{Ho}^{3+}$ .

## CINCINNATI, UNIVERSITY OF

222. RADIATION EFFECTS ON BCC REFRACTORY  
METALS AND ALLOYS \$38,000 01-03  
J. Moteff - Department of Materials  
Science and Metallurgical Engineering

Neutron damage in Nb Mo and W, temperature of irradiation from 425 to 1000°C, hardness, electrical resistivity and transmission electron microscopy, study of defects and their recovery kinetics.

## CLARKSON COLLEGE OF TECHNOLOGY

223. TRANSPORT AND MAGNETIC PHENOMENA  
IN CHROMIUM AND IRON ALLOYS \$25,896 02-02  
S. Araj - Department of Physics

Electrical resistivity, thermoelectric power, magnetization, thermal conductivity, Cr and Fe base alloys, Cr with Fe Ru Os Ni Mo Al, Fe with Ni Ge.

224. THE OXIDATION OF COPPER FILMS \$15,236 02-02  
A. W. Czanderna - Department of Physics (7 mos.)

Single crystal films of Cu, oxidation in temperature range of 25 to 200°C, optical transmittance and microbalance techniques.

## CLEMSON UNIVERSITY

225. RADIATION EFFECTS IN CRYSTALLINE  
MATERIALS \$38,450 02-03  
R. L. Chaplin - Department of Physics

Measure defects produced in metal crystals with energetic electrons, irradiations at 4.2°K for single crystal Al Cu Mg Zn, recovery kinetics.

## COLUMBIA UNIVERSITY

226. A STUDY OF THE FEASIBILITY OF  
OBTAINING FIELD ION MICROSCOPE  
IMAGES OF INTERSTITIAL SOLUTES \$38,000 01-02  
E. S. Machlin - Department of Metallurgy

Effect of heavy gas bombardment (Xe) on radiation damage of simple organic molecules, effect of microscope controllable parameters on the imaging character and stability of a few organic and bio-molecules.

227. DEFECTS IN CRYSTALS \$74,837 01-02  
A. S. Nowick - Department of Engineering (2 yrs.)  
and Applied Science

Point defects in crystals by the methods of dielectric and anelastic relaxation,  $\text{Cu}_2\text{O}$ ,  $\text{FeGe}_2$ , search for relaxation effects due to vacancies or substitutional atoms in crystals containing low symmetry sites, piezoelectric relaxation, defect reactions.

## CORNELL UNIVERSITY

228. DEFECTS IN METAL CRYSTALS \$184,363 01-03  
R. W. Balluffi and D. N. Seidman -  
Department of Materials Science  
and Engineering

Point defects, line defects and planar defects, annealing kinetics of vacancy defects in quenched gold at elevated temperatures, FIM and electrical resistivity study of vacancy defects in Pt and W, in-situ FIM studies of radiation damage in W and Pt irradiated with like ions, construction and development of an atom probe FIM, computer simulation of contrast effects produced by defects in FIM specimens.

229. STUDIES OF LOW TEMPERATURE PHASE  
TRANSFORMATIONS IN HIGH FIELD  
SUPERCONDUCTORS AND THE PHONON  
SPECTRUM AND MECHANICAL PROPERTIES  
OF VANADIUM \$29,480 01-02  
B. W. Batterman - Department of Materials  
Science and Engineering

Thermal diffuse x-ray scattering to measure phonon dispersion of V, precipitation of H in V at temperatures below room temperature, correlation of x-ray measurements with optical and mechanical properties of embrittled V and the formation of V hydride, structural transformations in  $\text{Nb}_3\text{Sn}$  and  $\text{V}_3\text{Si}$ .

## CORNELL UNIVERSITY (Continued)

230. AN ELECTROMIGRATION STUDY OF VOID  
KINETICS IN METALS \$74,946 01-03  
P. S. Ho - Department of Materials (2 yrs.)  
Science and Engineering

Electromigration method to study void formation and growth in Al and Au films subjected to gas ion bombardment, surface electromigration, vacancy properties in Al by theoretical calculations.

231. EFFECT OF ENVIRONMENT ON FRACTURE  
BEHAVIOR \$26,405 01-01  
H. H. Johnson - Department of Materials  
Science and Engineering

Role of hydrogen in fracture of steel, crack initiation stress intensities and crack growth rates, permeation measurements on biaxially stressed membranes to characterize thermodynamics and diffusion behavior of H in solution and the role of stress state in brittle behavior, diffusion of H in stress gradients.

232. A STUDY OF THE INTERACTION BETWEEN  
MAGNETIC FLUXOIDS AND CRYSTAL  
DEFECTS IN TYPE II SUPERCONDUCTORS \$33,566 01-02  
E. J. Kramer - Department of Materials  
Science and Engineering

Interaction between dislocations and flux lines in ductile type II superconductors by change in stress relaxation rate after a step change in magnetic field, stress relaxation in Pb alloy single crystals, surface pinning of fluxoids in Nb single crystals, time dependence of current-voltage curves to determine mechanism by which fluxoid lattice moves, fluxoid dislocation dipole mobility.

233. THEORETICAL PHONON PHYSICS \$63,500 02-02  
J. Krumhansl - Department of Physics

Theory of quantum and classical lattice excitations in condensed matter and their contributions to electrical, thermal and optical properties, studies of highly anharmonic solids, excitations in disordered systems, dynamics of defects in crystals, transport involving phonons, computer studies of liquids, ferroelectricity in crystals with dipolar impurities.



## CORNELL UNIVERSITY (Continued)

234. EXPERIMENTAL PHONON PHYSICS \$134,877 02-02  
R. O. Pohl and A. J. Sievers -  
Department of Physics

Study of phonons in crystals and in glasses using far infrared spectroscopy, measurements of heat pulses, specific heat, thermal conductivity, surface impedance of pure and doped metals and of semi-metals using far-infrared radiation, second sound in solids, cooperative phenomena in dilute dipolar systems, far infrared properties of metals impurity modes and composite structures.

235. A STUDY OF IMPERFECTIONS IN CRYSTALS \$57,236 02-02  
H. S. Sack - Department of Applied  
Physics

Study of  $\text{CN}^-$  in various alkali halides, dielectric measurements in a range up to 12  $\text{GHz}$  down to 0.03 $^\circ\text{K}$ , models for the position of the impurity and the potential field surrounding it,  $\text{KCl}:\text{Li}^+$  system for studies of orientation dependence and field dependence, anelastic measurements of  $\text{CN}^-$  and  $\text{Li}^+$  in alkali halides.

236. HARD SUPERCONDUCTING MATERIALS \$85,000 01-02  
J. Silcox and W. W. Webb - Department  
of Applied Physics

Critical current densities, magnetic hysteresis, energy losses and instabilities, surface currents, surface magnetization, flux creep in the superconducting sheath, fluctuations, radiation sensitivity and phase coherence in weak links, effects of lattice defects.

237. SOLID STATE PHYSICS: MAGNETIC PHENOMENA \$129,477 02-02  
R. H. Silsbee and R. Bowers -  
Department of Physics

Microwave resonance to elucidate off-center ions and molecular impurities in alkali halides, tunneling rate of  $\text{O}_2^-$  molecule, nature of the nearly free rotational states of the  $\text{NO}_2$  molecule, nuclear spin states of  $\text{N}_2^-$ ,  $\text{KCl}:\text{Li}^+$  system as a tunable source of monochromatic phonons, transmission electron spin resonance, helicon resonance, magnetoresistance in K, coupling of eddy currents to ions in metals as a means to generate ultrasound, electron-electron scattering in W.

## CORNELL UNIVERSITY (Continued)

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

System for making length change measurements combined with ultrasonic pressure measurements for an absolute pressure gauge and for measuring second derivatives of elastic constants, cryogenic system for low temperature-several hundred kilobar research, elastic changes in superconducting and normal Nb by CW method, elastic constants and pressure derivatives of  $V_3Si$ , Li, Na down to 4<sup>o</sup>K, creep in pure and doped LiF.

## DARTMOUTH COLLEGE

239. MEASUREMENT OF ELECTRON ENERGY  
BAND STRUCTURE IN CONDUCTORS BY  
MEANS OF MAGNETOPLASMA WAVES IN  
ELECTRON TUNNELING \$31,200 02-02  
J. R. Merrill - Department of Physics  
and Astronomy

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

## FLORIDA, UNIVERSITY OF

240. DEFORMATION PROCESSES IN  
HEXAGONAL METALS \$46,200 01-01  
R. E. Reed-Hill - Department of (18 mos.)  
Metallurgical and Materials Engineering

Dynamic strain aging in HCP metals Ti Zr, anomalous work hardening, strain rate dependent work hardening, interactions between interstitial atoms and moving dislocations, transmission electron microscopy, dislocation reactions on prism planes, elongation minima in Ti.

## GEORGETOWN UNIVERSITY

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

Electrical magnetic and thermal properties of pure metals at low temperatures in both the normal and superconducting states, ac susceptibility, dc susceptibility, heat capacity, electron tunneling, Ga In Sn Al Zn Pb, critical temperatures in alloys of Ga-In.

## GEORGIA INSTITUTE OF TECHNOLOGY

242. A STUDY OF THE STRUCTURE AND  
MECHANICAL PROPERTIES OF ORDERED  
ALLOYS \$36,000 01-01  
B. G. LeFevre and E. A. Starke, Jr. -  
School of Chemical Engineering

Relationship between microstructure and mechanical properties of ordered alloys Ni<sub>4</sub>Mo CuPt, measurements of long range order, domain size, internal strains, deformation modes, mechanical property measurements on single crystals.

243. MAGNETIC PHENOMENA AT METAL SURFACES \$80,795 01-02  
S. Spooner - Engineering Experiment (2 yrs.)  
Station

Study of ferromagnetic surfaces by neutron scattering and torque magnetometer measurements, Co films, magnetocrystalline anisotropy, studies of crystal field and spin-orbit electron interactions in FeCO<sub>3</sub>.

## HAWAII, UNIVERSITY OF

244. PHOTOELECTRIC EMISSION FROM THIN  
FILMS IN THE VACUUM ULTRAVIOLET  
REGION \$24,537 02-02  
W. Pong - Department of Physics  
and Astronomy

Photoelectric properties of thin films in the photon energy region 7 to 23 eV, attenuation of low energy photoelectrons, quantum yield and energy distribution of emitted photoelectrons as a function of thickness, films of PbTe PbS MgF<sub>2</sub> amorphous Se and Cu phthalocyanine.

## HOWARD UNIVERSITY

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

Thermoluminescence, infrared absorption, magnetic properties of synthetic and natural zircon, effects of natural alpha decay, neutron irradiation and fission products.

## ILLINOIS INSTITUTE OF TECHNOLOGY

246. THE STRENGTHENING AND TOUGHENING  
OF BRITTLE MATERIALS \$36,600 01-01  
L. J. Broutman - Department of  
Metallurgical and Materials Engineering

Effect of spherical particles on the strength, toughness and fracture surface energy of brittle materials, strength of composites fabricated from glass and alumina particles in a brittle polymer matrix, effect of particle size, volume concentration, mean free path and interface strength.

247. THERMAL MEASUREMENTS ON SOLIDS  
BELOW 1°K \$56,000 02-02  
H. Weinstock - Department of Physics

Low temperature thermal conductivity and specific heat measurements to study radiation induced defects, pyrolytic graphite, MgO, magneto-acoustic interactions via thermal conductivity for paramagnetic, antiferromagnetic and superconducting systems, heat capacity measurements on  $^{235}\text{UO}_2\text{Rb}(\text{NO}_3)_3$  and  $^{238}\text{UO}_2\text{Rb}(\text{NO}_3)_3$  to study electric quadrupole splitting of U nucleus.

## LEHIGH UNIVERSITY

248. FORMING OF COMPOSITE MATERIALS \$37,607 01-01  
B. Avitzur - Department of Metallurgy  
and Materials Science

Analytical and experimental research on plastic flow of composite material, hydrostatic extrusion of clad superconducting alloy, Nb-56% Ti clad with Al, effects of voids and inclusions on the behavior of tensile test specimens, techniques for extruding or drawing rod of multi-cored superconducting composites.

## LOUISIANA STATE UNIVERSITY

249. CONDUCTIVITY TENSORS IN METALS  
AND SEMICONDUCTORS \$55,205 02-02  
J. M. Reynolds - Department of Physics  
and Astronomy

Thermodynamic, transport properties, Fermi surface investigations, InSb Sb V NiS Zr Al Cd, single crystals of metals and semi-conductors, magnetic breakdown, electron-phonon scattering, magnetomorphic effects, magnetothermal effects, optical reflectance, resonance measurements.

## MARQUETTE UNIVERSITY

250. DEFECT STRUCTURES IN NON-  
STOICHIOMETRIC OXIDES \$32,979 01-02  
R. N. Blumenthal - Department of  
Mechanical Engineering

Defect structure and transport properties of defects in nonstoichiometric CeO<sub>2</sub>, single crystal and sintered CeO<sub>2</sub>, CaO-doped CeO<sub>2</sub>, electrical conductivity, Hall mobility, ionic transference and thermogravimetric measurements, effect of oxygen partial pressure, composition and temperature.

## MARYLAND, UNIVERSITY OF

251. CONDUCTION ELECTRONS AND MAGNETISM \$39,340 02-02  
J. R. Anderson and S. M. Bhagat -  
Department of Physics and Astronomy

Relationship between conduction electrons and ferromagnetism, Fe Co Ni Ni-Cu Gd, ferromagnetic resonance and de Haas-van Alphen effect measurements, resonance studies near the Curie temperature.

252. AN INVESTIGATION OF IRRADIATION  
STRENGTHENING OF BCC METALS AND  
SOLID SOLUTIONS \$38,000 01-03  
R. J. Arsenault - Department of  
Chemical Engineering

Neutron irradiation studies of BCC metals, rate controlling mechanism of low temperature plastic deformation, activation parameters for deformation, internal friction, transmission electron microscopy, V, V-Ti, Mo.

## MARYLAND, UNIVERSITY OF (Continued)

253. ALLOY STRENGTHENING DUE TO  
ATOMIC ORDER \$36,000 01-02  
M. J. Marcinkowski - Department of  
Mechanical Engineering

Deformation behavior of ordered alloys, dislocation structures of deformed ordered alloys,  $\text{Cu}_3\text{Au}$  FeCo, computer simulation of work hardening.

254. THE GALVANOMAGNETIC PROPERTIES OF  
GRAPHITE IN THE TEMPERATURE RANGE  
4-300°K AND PRESSURE RANGE  
0-10,000 kg/cm<sup>2</sup> \$30,000 01-01  
I. L. Spain - Department of Chemical  
Engineering

Magnetoresistance and Hall effect measurements on graphite, variation of carrier density and mobility with pressure and temperature, anisotropy of electrical conductivity in synthetic graphite crystals, natural graphite, relationship of measurements to electron and phonon spectra.

## MASSACHUSETTS INSTITUTE OF TECHNOLOGY

255. MECHANICAL PROPERTIES OF METALS \$23,420 01-01  
W. A. Backofen - Department of Metallurgy  
and Materials Science

Shear fracture in polycrystalline Zr, plane-strain ductility transition temperatures in textured Zircaloy-4 sheet, temperature dependence of tensile strength as a function of strain rate.

256. THERMAL NEUTRON SCATTERING STUDIES  
OF MOLECULAR DYNAMICS AND CRITICAL  
PHENOMENA IN LIQUIDS AND SOLIDS \$97,000 02-02  
S. H. Chen and S. Yip - Department of  
Nuclear Engineering

Automated 3-axis neutron spectrometer used to study molecular dynamics in liquids solids and gases, temperature and concentration dependence of long wavelength phonons in alkali halides, pressure dependence of the broadening of quasi-electric peak in gases and gas mixtures, hydrogen impurities in simple liquids, critical scattering from density and concentration fluctuations in liquids and liquid mixtures.

## MASSACHUSETTS INSTITUTE OF TECHNOLOGY (Continued)

257. BASIC RESEARCH IN CRYSTALLINE AND  
NONCRYSTALLINE CERAMIC SYSTEMS \$290,000 01-01  
W. D. Kingery and R. L. Coble -  
Department of Metallurgy and  
Materials Science

Kinetics of phase changes, diffusion, development of microstructure, relationship of properties to composition, crystal structure and microstructure, materials synthesis and preparation, diffusion in ZnO, defect structure versus density in single crystal  $Al_2O_3$ , creep in  $Al_2O_3$  doped with MgO, preparation of single crystal solid solutions of CoO-NiO FeO-MnO by chemical vapor transport, MgO- $Al_2O_3$   $ZrO_2$ - $Y_2O_3$ , tunneling phenomena in amorphous Si, sintering, pressure dependence of grain boundary diffusion, sintering of Ba Sr Mg titanates prepared by freeze drying, thermal gradient effects in  $UO_2$  FeO, influence of microstructure on strength of  $Al_2O_3$ , dislocation structure of  $UO_2$   $CaF_2$ .

258. LOW TEMPERATURE AND NEUTRON  
PHYSICS STUDIES \$122,595 02-02  
C. G. Shull - Department of Physics

Polarized neutron scattering studies of alloys containing dilute magnetic impurities which exhibit Kondo transitions, high field superconducting magnet used in study on diamagnetic scattering by Bi and of nuclear polarization scattering effects in crystals containing H, Pendellosung fringe structure from perfect Ge crystals.

## MASSACHUSETTS, UNIVERSITY OF

259. ULTRASONIC ATTENUATION STUDIES OF  
THE ELECTRONIC STRUCTURE OF METALS \$38,962 02-02  
A. R. Hoffman - Department of Physics  
and Astronomy

Magnetic field and temperature dependence of transport properties in Be, existence of diamagnetic domains, magnetic field dependence of acoustic absorption in K for sound waves propagating at oblique angles to magnetic field, magnetic field dependence of acoustic absorption in Nb near upper critical field, pulse-echo and continuous-wave techniques.

## MICHIGAN STATE UNIVERSITY

260. STUDIES OF ELECTRICAL AND DEFECT  
 PROPERTIES OF THIN METALLIC WIRES \$43,105 02-02  
 J. Bass - Department of Physics

Properties of vacancies and small vacancy complexes in BCC transition metals using technique of quenching fine wires in superfluid helium, electrical resistivity and field ion microscopy, positron lifetimes in Al and Al alloys to determine the binding energies between vacancies and impurities, thermopower of Ni Al In.

261. PROPERTIES OF RARE-GAS SOLIDS \$37,410 02-02  
 G. L. Pollack - Department of Physics  
 and Astronomy

Thermodynamic and surface property studies of solid Ar Kr Xe and Ne, liquid He film flow and hydrodynamics, thermal conductivity of Ar, anharmonicity, phonon mean-free paths, concentration and nature of defects, theoretical study of second sound in rare-gas solids, coupling between pressure and temperature waves in liquid He below the lambda temperature, other molecular solids such as N<sub>2</sub> O<sub>2</sub> CH<sub>4</sub> and NH<sub>3</sub>.

## MICHIGAN TECHNOLOGICAL UNIVERSITY

262. STRUCTURE AND PROPERTIES OF  
 SOLID SOLUTIONS \$43,796 01-01  
 A. A. Hendrickson - Department of  
 Metallurgical Engineering

Single crystals of dilute Ag alloys grown from the melt, critical resolved shear stress, creep rate, dislocation velocity, activation energies and areas for deformation, dislocation etch pitting and dislocation motion, for BCC metal solid solutions both athermal and temperature dependent solute strengthening, single crystals of Nb and Ta alloys, relation between experimental and theoretical predictions.



## MICHIGAN TECHNOLOGICAL UNIVERSITY (Continued)

263. EFFECT OF ANNEALING ON THE SUB-  
STRUCTURE OF COLD WORKED FCC  
METALS AND ALLOYS \$32,567 01-02  
D. E. Mikkola - Department of  
Metallurgical Engineering

Quantitative information concerning the changes in substructure which occur during the annealing of cold worked FCC metals and alloys, x-ray diffraction and transmission electron microscopy, annealing behavior of faults and dislocations in powders of Cu-Ge alloys, kinetics of antiphase domain growth in Cu<sub>3</sub>Au.

## MICHIGAN, UNIVERSITY OF

264. FISSION FRAGMENT INDUCED  
ELECTRICAL TRANSIENTS IN  
DIELECTRIC MATERIALS \$18,980 01-03  
D. R. Bach - Department of Nuclear  
Engineering

Soda glass used as an electrical transient detector for <sup>252</sup>Cf fission fragments, low pressure breakdown initiated by fission fragments between two plates at high electrical field.

265. THERMODYNAMIC PROPERTIES OF  
SOLID ALLOYS \$31,800 01-02  
R. D. Pehlke - Department of Chemical  
and Metallurgical Engineering

Thermodynamic properties using solid EMF cells, Ni-Cr and Fe-Cr alloy systems.

## MINNESOTA, UNIVERSITY OF

266. EXPERIMENTAL AND THEORETICAL  
STUDIES IN SOLID STATE AND  
LOW TEMPERATURE PHYSICS \$169,645 02-02  
A. M. Goldman, L. H. Nosanow,  
W. Zimmerman, Jr., and W. Weyhmann -  
Department of Physics

Thermal and intrinsic fluctuations in superconductors, superconducting properties of transition metal dichalcogenides, magnetic susceptibility and heat capacity of crystalline  $^3\text{He}$  down to 20 m $^{\circ}\text{K}$ , theory of quantum crystals, theory of liquid He, nuclear magnetic resonance and nuclear hyperfine interactions in Au, Cu, and Au-Cu alloys, quantized circulation and analogs of the Josephson effect in superfluid He, osmotic pressure and heat capacity in  $^3\text{He}$ - $^4\text{He}$  mixtures.

267. "IN-SITU" ELECTRON MICROSCOPE  
INVESTIGATION OF THE NUCLEATION  
AND GROWTH OF SPUTTERED THIN FILMS \$44,000 01-01  
T. E. Hutchinson - Department of Chemical  
Engineering and Materials Science

Mechanism of nucleation and growth of thin films formed by inert gas ion sputtering, Ag Au Cu Nb Si CdS on amorphous carbon and SiO and on single crystal Si, graphite substrates, effect of incident atom energy on nucleation and growth parameters, data correlation with thermally deposited films.

268. A STUDY OF GRAIN BOUNDARY SEGREGATION  
USING THE AUGER ELECTRON EMISSION  
TECHNIQUE \$48,055 01-01  
D. F. Stein - Department of Mechanical  
Engineering

Impurity segregation at fracture surfaces, low alloy steels, pure Fe Cu W Cr Ti Be, stainless steels, Cu-Bi-Fe alloys, grain boundary hardness in  $\text{Al}_2\text{O}_3$  doped with MgO and  $\text{Cr}_2\text{O}_3$ .

269. DIFFUSION STUDIES IN LIQUID METALS \$58,431 01-02  
R. A. Swalin - Department of Chemical  
Engineering and Materials Science

Self-diffusion of liquid In and Hg as a function of temperature at constant volume, thermotransport of Au Sb S in liquid Ag, alkali metals, electrical resistivity of liquid Li, x-ray diffraction studies of the radial distribution function for K.

## MONTANA STATE UNIVERSITY

270. HIGH-TEMPERATURE OXIDATION  
OF IRIDIUM \$23,898 01-01  
R. T. Wimber - Department of Aerospace  
and Mechanical Engineering

Oxidation of Ir in gas flow environments in the temperature range 1600-2200°C, theoretical steady-state oxidation rate equation.

## NEW YORK, STATE UNIVERSITY OF

271. THEORY OF REACTION KINETICS \$31,274 02-03  
J. W. Corbett - Department of Physics,  
Albany

Role of spatial correlation between reacting species on their reaction kinetics, recovery in discrete lattices and simultaneous production and diffusion limited recovery, continuum theory and the relation between continuum and discrete lattice results, applications to radiation damage and void formation, radiation chemistry, photochemistry, ionization yields, precipitation.

272. SLIP INITIATION AND MICRODYNAMICS  
OF PLASTIC FLOW \$30,000 01-01  
J. C. Bilello - Department of  
Materials Science, Stony Brook

Slip initiation and microdynamics of plastic flow by high resolution strain measurements, thermally activated slip in W, role of stress concentrations and grain boundaries in controlling flow in polycrystalline metals, solute and impurity dislocation interactions.

273. FATIGUE-ENHANCEMENT OF DIFFUSION \$14,945 01-01  
H. Herman - Department of Materials  
Science, Stony Brook

Enhanced diffusion during low amplitude cyclic straining of alpha brass, electrical resistivity, temperature, amplitude and frequency effects.

## NEW YORK, STATE UNIVERSITY OF (Continued)

274. THERMAL NEUTRON SCATTERING ON  
MAGNETIC MATERIALS AND LIQUIDS \$87,319 02-02  
R. Nathans - Department of Physics, (18 mos.)  
Stony Brook

Critical scattering of neutrons from  $\text{FeF}_2$ , dynamical structure factors in Te from neutron inelastic scattering intensity measurements, inelastic neutron scattering in  $^3\text{He}$ - $^4\text{He}$  mixtures as a function of liquid density.

275. PHYSICAL THEORY OF BRITTLE FRACTURE  
AND MECHANICAL PROPERTIES \$25,872 01-01  
R. M. Thomson - Department of Materials (9 mos.)  
Science, Stony Brook

Theoretical analysis of the atomic configuration near a crack tip, analog of dislocation kink theory will be investigated for the fracture crack, formation of dislocations at a crack tip, dislocation tunneling, impurity effects at a crack tip.

## NORTH CAROLINA STATE UNIVERSITY

276. DIFFUSION OF GASES IN SOLIDS \$31,345 01-03  
T. S. Elleman - Department of Nuclear  
Engineering

Rare gas diffusion in ionic crystals, T diffusion through metals,  $\text{UO}_2$  single crystals doped with  $^{133}\text{Xe}$ , rare gas release during isothermal annealing, T diffusion in 304-stainless steel and zircalloy at low concentrations.

277. AN EXPERIMENTAL INVESTIGATION OF  
BOILING BUBBLES \$24,224 01-01  
R. F. Saxe - Department of Nuclear  
Engineering

Effects of various gaseous and liquid parameters on the emission of sound by boiling bubbles, development of a dynamic model of boiling bubble growth and collapse, acoustical measurements, high speed photography,  $\text{H}_2\text{O}$ .

## NORTH CAROLINA, UNIVERSITY OF

278. INVESTIGATION OF DEFECT STRUCTURES  
 BY ELECTRIC POLARIZATION AND  
 RELAXATION METHODS \$34,044 02-02  
 J. H. Crawford, Jr. - Department  
 of Physics

Studies of composite imperfections (cation-anion vacancy pairs, vacancy-impurity complexes) by means of dielectric behavior, polarized optical absorption, emission of polarized light, electron spin resonance, nuclear magnetic resonance, alkali halides, alkaline earth halides, divalent transition metal halides.

279. THE PROPERTIES OF METALS AND ALLOYS \$63,000 02-02  
 L. D. Roberts - Department of Physics

Mössbauer recoilless fraction as a function of temperature for Au in a number of alloys, isomer shift for alloys, order-disorder effects in alloys, x-ray chemical shifts in alloys, calculation of atomic wave functions, pressure dependence of the Kondo temperature, Mössbauer isotopes  $^{197}\text{Au}$   $^{133}\text{Cs}$   $^{119}\text{Sn}$   $^{57}\text{Fe}$ .

280. ATOMIC DIFFUSION AND POINT DEFECTS  
 IN CRYSTALS \$37,912 02-02  
 L. Slifkin - Department of Physics (17 mos.)

Effect of transverse magnetic field on cation diffusion in Al and dilute Al alloys, EPR studies of Mn doped AgCl, studies of cation doping on impurity diffusion in Ag halides, internal friction studies of vacancy formation and dislocation pinning in AgBr.

281. PRESSURE VARIATION OF SINGLE  
 CRYSTAL ELASTIC CONSTANTS \$44,852 02-02  
 C. S. Smith - Department of Physics (18½ mos.)

Pressure variation of the single crystal elastic constants of Li halides, temperature coefficients of the elastic constants at constant volume, pressure derivative of the isothermal bulk modulus.

## NORTH DAKOTA, UNIVERSITY OF

282. PHYSICAL PHENOMENA IN CRYSTALS  
 CONSISTING OF A FINITE AND  
 COUNTABLE NUMBER OF ATOMS IN  
 ONE DIRECTION \$36,000 02-02  
 H. H. Soonpaa - Department of Physics

Properties of cleaved films of  $\text{Bi}_8\text{Te}_7\text{S}_5$ , optical constants as a function of thickness, superconducting tunneling, electrical and galvanomagnetic phenomena.

## NORTHEASTERN UNIVERSITY

283. STRUCTURAL, THERMAL, AND ELECTRONIC  
 PROPERTIES OF METASTABLE BINARY  
 ALLOYS OF THORIUM AND URANIUM  
 PRODUCED BY RAPID QUENCHING \$30,000 01-01  
 B. C. Giessen - Department of Chemistry

Study of splat cooled foils of Th and rare-earth metals as one component with addition of Fe Co Ni or Cu, crystal chemistry, density, magnetic moment, Mössbauer spectroscopy, calorimetry, kinetic studies.

284. CALORIMETRIC STUDIES OF SUPER-  
 CONDUCTORS \$34,964 02-02  
 C. A. Shiffman - Department of Physics

Proximity effect in superconductors, measurements of specific heat of lamellar eutectic alloys with alternate plates of superconducting and normal phases, dependence of the excess superconductive ordering on temperature, lamellar thickness and magnetic field, Sn-Pb Sn-Zn Au-Tl.

## NORTHWESTERN UNIVERSITY

285. ELECTRONIC BAND STRUCTURE AND  
 PHYSICAL PROPERTIES OF THE  
 ACTINIDE METALS AND THEIR COMPOUNDS \$34,223 02-02  
 A. J. Freeman - Department of Physics

Theoretical study of electronic band structure of the actinide metals, symmetrized relativistic augmented plane wave method, FCC and BCC Th, BCC U, FCC Pu Am Cm.

## NORTHWESTERN UNIVERSITY (Continued)

286. EFFECT OF POINT DEFECTS ON  
MECHANICAL PROPERTIES OF METALS \$47,000 01-01  
M. Meshii - Department of Materials  
Science

Effect of electron irradiation on strength, Fe, irradiations at 4.2 to 80°K, interaction between dislocations and vacancies or interstitials, rapid quenching to produce vacancies, electron microscopy.

## OHIO STATE UNIVERSITY

287. AN INVESTIGATION OF MIXED CONDUCTION  
IN SOLID ELECTROLYTES \$8,457 01-02  
R. A. Rapp - Department of  
Metallurgical Engineering

Electronic conduction in fused salt system NaCl-TiCl<sub>x</sub>, electro-chemical cells involving either Pyrex or beta-Al<sub>2</sub>O<sub>3</sub> electrolytes to fix the chlorine activity, dependence of electronic conductivity contribution on the total Ti content and Ti<sup>2+</sup>/Ti<sup>3+</sup> ratio.

288. LIQUID METALS RESEARCH \$37,005 01-02  
D. A. Rigney - Department of  
Metallurgical Engineering

Scattering calculations for electrotransport in liquid monovalent metals, Li Na K Rb Cu Ag Au and binary alloys, experimental high temperature measurements in Na-K Na-Rb and Li alloys, super-cooling in liquid metals.

## OKLAHOMA, UNIVERSITY OF

289. THE EFFECTS OF SURFACE COATINGS ON  
THE PLASTIC DEFORMATION OF METAL  
SINGLE CRYSTALS \$29,666 01-01  
R. J. Block - School of Chemical  
Engineering and Materials Science

Effects of surface coatings on the stress-strain behavior of single crystals, Al, dislocation etch-pit density measurements, evaporated coatings, fatigue behavior.

## OKLAHOMA, UNIVERSITY OF (Continued)

290. THERMOELECTRIC SIZE EFFECT  
 IN NOBLE METALS \$27,500 02-02  
 R. R. Bourassa - Department of Physics  
 and Astronomy

Thermoelectric size effects in noble metals Au Cu Ag, thermo-  
 electric power of lattice vacancies in Al.

## OREGON STATE UNIVERSITY

291. NATURAL CONVECTION HEAT TRANSFER  
 IN LIQUID METALS \$19,974 01-01  
 J. R. Welty - Department of Mechanical  
 and Nuclear Engineering

Natural convection phenomena in low Prandtl number fluids-liquid  
 metals, single vertical plane wall in Hg, velocity profiles,  
 temperature profiles.

## PENNSYLVANIA STATE UNIVERSITY

292. NONLINEAR ELASTIC AND THERMO-  
 ELASTIC PROPERTIES OF MATERIALS \$52,821 02-02  
 G. R. Barsch - Materials Research  
 Laboratory

Third order elastic constants, pressure dependence of elastic  
 constants of alkali halides,  $UO_2$ , ZnS, ZnO,  $V_3Ge$ , CsI, fourth  
 order elastic constants of vitreous silica, strain dependence of  
 phonon frequencies, thermal equation of state.

293. CERAMIC RESEARCH ON TRANSFORMATIONAL  
 SUPERPLASTICITY AND FERROELECTRIC  
 DOMAIN BOUNDARIES \$26,789 01-01  
 R. C. Bradt and J. H. Hoke - Department  
 of Material Sciences

Mechanical behavior of Bi oxide eutectoid systems during thermal  
 cycling about the transformation temperature, transmission electron  
 microscopy of  $90^\circ$  and  $180^\circ$  ferroelectric domain boundaries in  
 $BaTiO_3$ .



## PENNSYLVANIA STATE UNIVERSITY (Continued)

294. THERMODYNAMIC PROPERTIES OF SOLID SOLUTIONS AT HIGH TEMPERATURES \$28,000 01-02  
A. Muan - Department of Geochemistry and Mineralogy

Studies of oxide phases at elevated temperature to determine energetics of compound formation and solid-solution behavior, titanates, chromites, aluminates and silicates, ZnO-NiO-SiO<sub>2</sub>, Mg-Fe-Ni-Si-O, correlation and interpretation of data on oxide and silicate systems.

295. RESEARCH ON GRAPHITE \$109,354 01-01  
P. L. Walker, Jr. - Department of Material Sciences

Internal friction studies of neutron irradiated graphite, internal friction studies of composite systems involving graphites and carbons, graphitization of carbons produced by ultra-high pressure carbonization of organic compounds, gas chemisorption on carbon surfaces, metal oxide reduction by graphite, reaction of O<sub>2</sub> and CO<sub>2</sub> with graphite, graphitization of pyrolytic carbons, graphite crystal growth by the traveling solvent method.

## PENNSYLVANIA, UNIVERSITY OF

296. DISLOCATION MOBILITIES IN ORDERED ALLOYS \$25,000 01-01  
D. P. Pope - Department of Metallurgy and Materials Science

Mechanism of strengthening in Ni<sub>3</sub>Al, Cu<sub>3</sub>Au, dislocation velocities in single crystals.

## PITTSBURGH, UNIVERSITY OF

297. PRECIPITATION HARDENING IN COPPER-TITANIUM ALLOYS \$31,000 01-02  
W. A. Soffa - Department of Metallurgical and Materials Engineering

Kinetics and mechanism of decomposition of supersaturated Cu-Ti alloys, x-ray diffraction, transmission electron microscopy, mechanical properties.

## PITTSBURGH, UNIVERSITY OF (Continued)

298. A STUDY OF RADIATION INDUCED  
DEFECTS IN METALS \$31,000 02-03  
J. R. Townsend - Department of Physics

Radiation-induced defects in Cu W Al, irradiation with 10 MeV protons, Young's modulus and internal friction measurements from 4.2°K to room temperature, piezo-resistance measurements to detect stress induced ordering.

299. THERMAL, STRUCTURAL AND MAGNETIC  
STUDIES OF METALS AND INTER-  
METALLIC COMPOUNDS \$95,003 02-02  
W. E. Wallace and R. S. Craig -  
Department of Chemistry

Electrical resistivity measurements on compounds containing rare earths to study Kondo effect and superconductivity, heat capacity measurements from 10 to 300°K using automatic adiabatic specific heat calorimeter, magnetic properties of ternary systems containing lanthanides and cobalt, pulse calorimetry in the range 1.5 to 4°K.

## PURDUE UNIVERSITY

300. DIFFUSION AND PRECIPITATION OF  
INERT GASES IN METALS \$45,000 01-03  
J. R. Cost - School of Materials Science  
and Metallurgical Engineering

Study of He implanted in Al and Nb, characterization of site occupancy, temperature dependence of the atomic jump rate, precipitation process to form gas bubbles, internal friction, lattice parameter, resistivity, electron microscopy, low temperature specific heat near the lambda point of He.

301. TRANSPORT AND THERMODYNAMIC  
PROPERTIES OF SOLIDS \$36,000 01-02  
R. E. Grace - Department of  
Metallurgical Engineering

Atomic mobilities, intrinsic diffusion coefficients, interdiffusion coefficients in both vapor-solid and solid-solid diffusion couples, Cu-Zn Ni-Zn Cu-Zn-Ni, Ag-Zn Ag-Cd Ag-Zn-Cd, electron microprobe analysis, characterization of lattice defects and their transport properties in CaWO<sub>4</sub>, formation of FeS on wustite substrates.

## PURDUE UNIVERSITY (Continued)

302. BASIC RADIATION DAMAGE STUDIES \$56,711 02-03  
J. W. MacKay - Department of Physics

Electron radiation damage in Ge and Si at low temperatures, electrical properties and optical absorption, radiation annealing and thermal annealing.

303. <sup>57</sup>Fe MOSSBAUER STUDIES OF THE PROPERTIES OF SOLIDS \$30,000 02-02  
J. G. Mullen - Department of Physics

Diffusion of <sup>57</sup>Fe in FeO CoO and NiO, effects of oxygen partial pressure on the cation vacancy concentration, effect of particle size and effects due to interaction of colloidal particles with the host liquid by measuring the temperature dependence of Mössbauer linewidth and recoil-free fraction.

## RENSSELAER POLYTECHNIC INSTITUTE

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

Effect of pressure on the principal-axis diffusion coefficients in hexagonal metals, vacancy activation volumes in Zn Cd Tl, pressure vessel maintained at temperature by a molten Sn bath, temperature dependence of the activation volumes, pressure dependence of the activation entropy.

305. ANISOTROPIC DIFFUSION AND ELECTROMIGRATION \$62,000 02-02  
H. B. Huntington - Department of Physics and Astronomy

Diffusion in non-cubic metals and electromigration in pure metals and alloys, thin sectioning technique, enhancement of self-diffusion by dilute impurities, Zn Au Ag Cu Cd Hg In Ga Sn in Zn, Au Ag Cd Zn In in Cd, electromigration in Au Ag Cu Al In Ga Na Na-K Co Pt U Zr Ti Zn Cd.

## RENSSELAER POLYTECHNIC INSTITUTE (Continued)

306. RESEARCH IN POWDER METALLURGY \$34,000 01-01  
F. V. Lenel - Materials Division

Sintering of Ag single crystal disks 5 microns in diameter in the electron microscope, microprobe measurements on sintered Ag-Cu with Ag-Au wires, fracture in Fe powder compacts, surface configuration of Fe powders by scanning electron micrography.

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

Strengthening in HCP alloys of various axial ratios in the presence of second phase particles, fracture processes, Mg-Th-Zr, Hf alloys, tensile tests from 4.2°K to 298°K, effect of O in solution and H in the form of hydrides on slip, twinning and fracture in Hf.

## SOUTHERN CALIFORNIA, UNIVERSITY OF

308. MATERIALS RESEARCH ON HIGH-  
FIELD SUPERCONDUCTORS \$90,000 02-02  
Y. B. Kim - Departments of Physics  
and Electrical Engineering

Superconducting and metallurgical properties of intermetallic compound superconductors sintered in Cu, superconducting properties of rapidly quenched alloys, flux pinning, spin-orbit interactions in high field superconducting alloys.

309. THE EFFECTS OF ELECTRIC AND  
MAGNETIC FIELDS ON THE NUCLEATION,  
STRUCTURE, AND RESIDUAL PROPERTIES  
OF VAPOR DEPOSITED METAL FILMS \$32,000 01-02  
L. E. Murr - Departments of Materials  
Science and Electrical Engineering

Effect of magnetic fields on nucleation and growth of vapor deposited Fe Co and Ni, structure and distribution of nuclei of vapor-deposited In Pb Au Ag Cd Sn Pd Co Fe Ni Pt, field ion microscopy and electron microscopy.

## STANFORD UNIVERSITY

310. STRUCTURE DEPENDENCE OF HIGH  
TEMPERATURE DEFORMATION OF METALS \$49,264 01-01  
C. R. Barrett and W. D. Nix -  
Department of Materials Science

Rate controlling creep mechanism in superplastic deformation, effects of He and He bubbles on the structure and high temperature creep of Ni-W alloys, effect of shock deformation on carbide strengthened nickel base alloys, influence of precipitate free zones in high temperature creep ductility.

311. NITRIDE FORMING REACTIONS IN  
LIQUID URANIUM ALLOYS \$41,872 01-01  
N. A. Parlee - Department of Mineral  
Engineering

Nitride forming reactions of gaseous N with liquid U alloys using a Sieverts type apparatus to measure pressure and volume of N taken up or evolved, UN and U<sub>2</sub>N<sub>3</sub> formation in U-Sn alloys, effect of nitride formers such as Zr Pr or Eu in the U-Sn alloy.

## SYRACUSE UNIVERSITY

312. IN SITU ULTRA HIGH VACUUM HIGH  
ENERGY ELECTRON DIFFRACTION STUDIES \$30,444 01-02  
R. Vook - Department of Chemical  
Engineering and Metallurgy

Surface studies and thin film epitaxy, Cu-Ag, Cu-O, Ni-Cr bilayers, ultra high vacuum reflection high energy electron diffraction, transmission electron microscopy, structural changes that occur as thin films nucleate and grow, CaF<sub>2</sub> on NaCl, NaCl on mica, Ge or Si on CaF<sub>2</sub>.

## TEMPLE UNIVERSITY

313. A STUDY OF THE IB-IIB  
BETA PHASE ALLOYS \$60,000 01-02  
L. Muldawer and H. Amar - Department  
of Physics

Piezorefectivity studies in alpha-AuZn, Hall effect measurements in AgZn alloys, high temperature resistivity studies, critical phenomena in specific heat and resistivity as found in Heusler alloys, Bragg-Williams calculations of order in ternary alloys, x-ray diffraction studies of ternary ordering, calculations and theory of ordered binary alloys, energy band structure calculations Cu-Au Zn, transport property calculations and applications of many body techniques.

## TENNESSEE, UNIVERSITY OF

314. APPLICATION OF ADIABATIC  
CALORIMETRY TO METAL SYSTEMS \$26,264 01-01  
E. E. Stansbury and C. R. Brooks -  
Department of Chemical and  
Metallurgical Engineering

Heat capacity of Pt from 25°C to 1000°C, calorimetric study of the Ni-Co system, order-disorder reactions near Ni<sub>2</sub>Co composition, Pb Zn Ni-Cr.

315. STUDY OF A NEW METHOD FOR PREPARING  
ULTRA-FINE GRAINED METAL ALLOYS \$15,499 01-01  
J. E. Spruiell - Department of Chemical  
and Metallurgical Engineering

Preparation of fine grained metal alloys (in the 1-10 micron range), properties of fine grained alloys, austenitic stainless steel, microstructural stability to thermal-mechanical treatments.

## TEXAS, UNIVERSITY OF

316. ELEVATED TEMPERATURE MORPHOLOGICAL  
STABILITY OF METAL MATRIX FIBER  
COMPOSITES \$17,706 01-01  
T. H. Courtney - Department of  
Mechanical Engineering

Thermal stability of composite materials, Al-Al<sub>3</sub>Ni composite, shape instability of fibers, elevated temperature mechanical properties, eutectic composites, quantitative metallography following elevated temperature exposure, role of fiber-matrix interface.

## TUSKEGEE INSTITUTE

317. DENSITY DETERMINATIONS USING A  
GAMMA RADIATION ATTENUATION  
TECHNIQUE \$38,000 01-01  
I. G. Dillon - School of Engineering

Densities of Cs and Li from room temperature to 1100°K, gamma ray attenuation technique using <sup>137</sup>Cs source, system to operate up to 2500°K with new liquid metal capsules.

## UTAH, UNIVERSITY OF

318. POSITRON LIFETIME MEASUREMENTS AS A  
NON-DESTRUCTIVE TECHNIQUE TO  
MONITOR FATIGUE DAMAGE \$30,008 01-01  
J. G. Byrne - Division of Materials  
Science and Engineering

To utilize measurements of the distribution of positron lifetimes to measure the degree of fatigue damage, assemble and check out delayed slow-fast coincidence circuit to measure positron lifetimes, Al, Cu deformed in simple tension first, separate effects due to grain boundaries, line and point defects.

## UTAH, UNIVERSITY OF (Continued)

319. IMPURITY EFFECTS ON THE CREEP OF  
POLYCRYSTALLINE MAGNESIUM AND  
ALUMINUM OXIDES AT ELEVATED  
TEMPERATURES \$25,027 01-01  
R. S. Gordon - Division of Materials  
Science and Engineering

Four point loading creep measurements between 1350 and 1600°C on Al<sub>2</sub>O<sub>3</sub>, effect of cation dopants Fe Cr Ti Sn, effect of stress and oxygen partial pressure, microstructural changes during creep, role of impurities in controlling diffusional, grain boundary or dislocation mechanisms of creep, MgO also.

320. THE FUNDAMENTALS OF RADIATION DAMAGE \$88,170 02-03  
A. Sosin - Department of Physics

Accelerator radiation bombardment using electrons currently and positive ions also, defect annealing in Cu below 60°K, interaction of dislocations with point defects.

## VERMONT, UNIVERSITY OF

321. THERMODYNAMIC AND TRANSPORT  
PROPERTIES OF INTERSTITIAL  
HYDROGEN ISOTOPES IN PALLADIUM \$14,059 02-02  
J. S. Brown - Department of Physics

Theory for electronic and atomic properties of interstitial PdH<sub>n</sub> alloys, phonon dispersion and dielectric screening in pure Pd.

## VIRGINIA, UNIVERSITY OF

322. ELECTRONIC PROPERTIES OF METALS  
AND ALLOYS \$70,000 02-02  
R. V. Coleman - Department of Physics

Ferromagnetic metals, high field magnetoresistance, Hall effect, thermal conductivity, Lorenz number, domain structure effects, Fe Co, electron tunneling and electronic switching phenomena in thin film metal oxide sandwiches with transition metal oxide barriers, tunneling and electronic conductivity in transition metal dichalcogenides, optical reflectivity in single crystal alloys (Cu-Al).



## VIRGINIA, UNIVERSITY OF (Continued)

323. INVESTIGATIONS ON THE BEHAVIOR  
OF POINT DEFECTS AND DISLOCATIONS \$68,500 02-02  
D. Kuhlmann-Wilsdorf - Departments of  
Materials Science and Physics

Stresses due to dislocation arrays, electron diffraction contrast of crystal defects, mechanical properties of crystalline materials, order-disorder phenomena, melting of small particles, epitaxy and pseudomorphism, martensitic transformation, elastic constant-interatomic potential relationships, annealing kinetics.

324. DYNAMIC DISLOCATION PHENOMENA IN  
SINGLE CRYSTALS OF METALS  
AND ALLOYS \$75,000 02-02  
J. W. Mitchell - Department of Physics (18 mos.)

Dislocation mechanisms involved in the deformation of Cu-Al alloys, dynamics of the relaxation processes, dislocation velocities, second and third order elastic constants, surface generation of dislocation avalanches.

## WAKE FOREST UNIVERSITY

325. A STUDY OF ATOMIC MOBILITIES  
IN CRYSTALLINE SOLIDS \$36,504 02-02  
T. J. Turner and G. P. Williams, Jr. - (2 yrs.)  
Department of Physics

Atomic mobilities in metals and ionic crystals, internal friction, resistivity, optical absorption, dielectric relaxation, MgO, Ag-Au, CaO, SrO, formation and thermal decay of centers produced by deformation in alkaline-earth oxides.

## WASHINGTON, UNIVERSITY OF

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

Measurements of the Mossbauer effect in solids under pressures up to 300 Kb, internal magnetic field and isomer shift of transition metals, Invar alloys, alloys and compounds containing Fe-57, recoilless fraction of Fe-57 in Cu, magnetic ordering in Fe at high pressures and low temperatures.

## WASHINGTON, UNIVERSITY OF (Continued)

327. A STUDY OF PHASE TRANSFORMATIONS  
AND SUPERCONDUCTIVITY \$35,878 01-01  
D. H. Polonis - Department of Mining,  
Metallurgical and Ceramic Engineering

Effects of thermal treatments and plastic deformation on the structure and properties of alloys, Ti-Cr, Ti-V, Ti-Nb, Zr-Nb, Ti-Fe, phase separation reactions and mechanisms, x-ray diffraction, electron microscopy, precipitation of intermetallic phases in Ti and Zr base alloys.

## WAYNE STATE UNIVERSITY

328. ELECTRON PARAMAGNETIC RESONANCE  
STUDIES OF RADIATION EFFECTS  
IN SOLIDS AND CHEMICAL COMPOUNDS \$47,000 02-03  
Yeong-Wook Kim - Department of Physics

Nature and effects of defects introduced in solids by radiation and doping, alkali halides, phosphors, superconducting materials, microwave spectroscopy, optical spectroscopy, electron-nucleus double resonance, electrical resistivity, electron tunneling.

## WISCONSIN, UNIVERSITY OF

329. CREEP MECHANISMS IN BCC ALLOY  
CRYSTALS \$8,000 01-01  
R. A. Dodd - Department of Metallurgical (4 mos.)  
and Mineral Engineering

Slip and high temperature creep in CsCl-type compounds, NiAl, CoAl, CuZn, FeAl, NiGa, AuZn, AuMg, creep behavior of Al-rich NiAl, transmission electron microscopy, tension and compression creep.



## 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, 1971, the Metallurgy and Materials Programs total support level amounted to about \$26.8 million in operating funds and \$1.6 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 \$26.8 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.)	45.9	21.9
(b) South ..... (S.C., Fla., Ga., La., N.C., Tenn., Ala., Va., Puerto Rico)	9.8	22.6
(c) Midwest ..... (Ohio, Ill., Wisc., Mich., Minn., N.D., Ind., Iowa)	22.3	41.6
(d) West ..... (Ariz., Utah, Calif., Mont., Okla., Oregon, Texas, Wash., Hawaii)	22.0	13.9

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-)	54.0	45.2
(b) Physics, Solid State Science, Solid State Physics (Office Budget Activity Numbers 02-)	46.0	54.8

SUMMARY OF  
FUNDING LEVELS

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) .....	45.3
(b) Laboratory Program .....	54.1

4. By Laboratory:

	<u>Total Program (%)</u>
Ames Laboratory .....	9.9
Argonne National Laboratory .....	21.2
Brookhaven National Laboratory .....	11.1
Illinois, University of (Materials Research Laboratory) .....	5.0
Lawrence Radiation Laboratory/Berkeley .....	6.8
Mound Laboratory .....	.4
Oak Ridge National Laboratory .....	19.5
Pacific Northwest Laboratory .....	1.9
Puerto Rico Nuclear Center .....	.6
Contract Research .....	23.6

SUMMARY OF  
FUNDING LEVELS

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5. By Selected Areas of Research:

	Number of Projects (Total=245) <u>(%)</u>	Total Program \$ <u>(%)</u>
(a) Materials		
Actinide Metals and Compounds .....	10.3	6.9
BCC Refractory Metals .....	13.5	7.1
Ceramics .....	14.3	9.7
Rare Earth Metals and Compounds ....	11.1	7.0
(b) Technique		
Neutron Scattering .....	7.0	14.9
Theory .....	14.7	9.3
(c) Phenomena		
Diffusion .....	9.4	5.5
Strength .....	19.6	10.7
Superconductivity .....	12.0	8.5
Surface Phenomena and Thin Films ...	17.2	10.5
Void Formation .....	5.7	2.7
(d) Environment		
High Pressure .....	8.6	4.7
Hydrogen .....	5.7	2.0
Radiation .....	14.7	15.6

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

Actinide Metals and Compounds

1	48	112
2	87	214
5	88	247
11	89	257
17	93	276
21	96	283
22	99	285
31	102	292
32	110	311

Ceramics

<u>Carbides</u>	<u>Glass</u>	<u>Nitrides</u>	<u>Oxides</u>			
21	13	26	2	72	101	257
22	72	31	3	73	102	276
67	74	51	17	74	104	292
88	219	99	18	78	109	293
94	246	211	20	88	112	294
98	264	311	22	89	227	301
101	292		32	96	245	303
107			40	97	246	319
			42	99	250	322

Composites

5
35
36
55
75
80
246
248
316

Graphite and Carbon

34	246
75	247
94	254
99	267
105	295

## Intermetallic Compounds

3	39	227
4	41	229
9	54	242
10	63	253
13	69	263
21	73	274
22	77	292
26	79	296
30	89	299
34	92	308
36	99	313
37	103	314
	212	329

## Ionic Crystals

Alkali Halides

14	102
25	104
27	235
47	237
63	238
66	278
96	281
99	292
	328

Other

15	47	221
16	50	234
25	62	243
26	66	244
32	114	247
37	203	257
38	211	280
40	214	325
42	218	

## Liquids

5	233
26	256
30	269
61	274
72	277
75	287
84	288
85	291
87	311
206	317



MATERIALS

- A9 -

Metals

<u>Alkali</u>	<u>HCP</u>		<u>BCC Refractory</u>		<u>Ferrous</u>	
12	2	202	1	92	7	207
18	5	208	2	93	21	208
26	18	218	5	96	22	216
89	23	240	6	99	48	223
95	50	255	7	113	52	231
201	89	259	9	208	53	268
206	91	304	18	216	54	286
237	92	305	23	222	61	306
238	99	307	36	228	62	309
259			51	229	70	315
269			53	252	71	322
288			61	262	76	326
317			69	268		
			73	272		
			89	286		
			91	300		

Organics

32  
46  
62  
71  
99  
115  
226  
244

Rare Earth Metals and Compounds

2	16	99
3	21	101
4	22	103
5	26	211
8	31	214
9	33	221
10	40	250
11	41	251
15	89	299

MATERIALS

- A10 -

Semiconductors

13	101
26	105
49	106
68	249
71	258
81	302
99	312

Solid and Liquid Inert Gases

	<u>Helium</u>	<u>Other</u>
15	202	12
28	205	37
30	213	45
35	215	65
65	266	116
	274	261

## Elastic Constants

4	238
18	281
63	292
65	324

## Electrical Resistance

9	62	90	222	273
11	75	100	223	290
13	77	108	225	299
17	80	113	228	302
18	85	115	249	322
23	86	202	254	325
35	87	209	259	327
46	89	211	260	

## Electron Microscopy

7	70	105	228	293
24	71	113	240	297
34	73	210	252	306
55	74	217	253	309
60	92	219	263	327
68	98	222	286	329

## Electron Scattering

6	106
35	209
45	219
71	268
92	312
93	

## Electron Spin Resonance

27	102	278
30	104	280
32	115	328
47	237	

## Field Ion Microscopy

20	226
71	228
73	260
220	309

## High Temperature Heat Capacity

4
79
89
314

## Infrared Spectroscopy

14
27
83
86
234
245

## Internal Friction

48	235
53	280
61	295
67	298
108	300
216	325
227	

## Laser Beam Scattering

6
65
84
221

## Low Temperature Specific Heat

4	29	247
11	52	266
12	89	284
16	234	299
21	241	300

## Magnetic Susceptibility

4	52	213
9	54	218
11	82	223
16	205	266
17	209	279
21	211	283
28	212	299

## Mossbauer Effect

17	62	218
21	203	283
31	204	303
52	209	326

## Neutron Scattering

15	40	114
22	41	243
26	42	256
37	43	258
38	101	274
39	103	

## Nuclear Magnetic Resonance

9	82
10	211
21	251
30	266
59	278
66	

## Optical Absorption

14	62	224
16	97	278
21	104	282
27	115	302
34	116	325
47	214	328

## Sputtering

13
60
111
212
267

## Stress-Strain

1	53	88	216	255	293
7	55	91	231	257	296
17	69	92	240	262	307
19	70	110	242	268	310
23	72	113	246	272	319
36	74	207	252	286	329
51	76	210	253	289	

## Theory

9	19	56	201	256	299
11	20	69	207	266	305
14	21	81	213	271	308
15	33	84	214	275	313
16	44	95	218	285	321
18	50	107	233	298	323

## Thermal Conductivity

3	87	247
13	89	291
64	223	322
67	234	

## Thermodynamics

2	88
4	96
12	112
21	206
28	250
30	257
78	261
79	

## X-Ray Scattering

4	75	210
22	94	217
30	98	229
49	105	263
51	106	269
54	110	297
62	112	300
65	113	313
67	206	327
68	209	

## Channeling

20  
24  
68  
107  
109

## Crystal Structure, Atomic Distribution and Crystal Transformations

4	54	105	229	283
17	60	110	238	297
21	67	112	242	299
30	71	206	253	314
37	75	209	257	323
49	94	217	258	327
51	97	226	269	

## Diffusion

5	74	276
18	96	280
20	202	300
53	215	303
59	230	304
61	231	305
64	257	321
72	273	

## Dislocations

19	105	263
20	106	272
24	108	275
36	208	286
53	216	296
55	228	310
67	232	318
69	240	320
73	252	323
91	253	324
92	262	



## Electron Transport

9	46	86	241	282
11	60	89	244	287
13	62	100	249	288
17	77	209	251	290
29	80	211	254	302
35	85	223	264	322
			269	328

## Electronic Structure

Fermi SurfaceOther

9	81	9	41	95	237
17	107	13	44	107	239
31	201	14	52	203	251
64		21	81	211	259
		31	83	214	285
		33	84	218	313

## Magnetism

4	16	28	44	114	223	279
9	17	31	52	204	237	283
10	21	38	66	209	243	299
11	22	39	82	211	266	326
15	26	40	103	218	274	

## Materials Preparation and Characterization

2	42
8	99
25	257

## Phonons

12	28	89	233	256
13	33	101	234	261
15	37	107	237	274
26	65	221	247	292
			254	321

## Point Defects

7	47	88	113	235	286
18	48	96	116	245	298
20	50	98	202	250	302
23	53	100	215	252	304
24	59	102	225	260	305
27	63	104	227	271	318
32	64	107	228	278	320
34	68	108	230	280	328

## Precipitation

1	72	228
20	90	229
48	91	230
50	105	297
51	113	307
56	210	309
61	219	310
		311

## Recovery and Recrystallization

23	92	222
34	98	263
48	108	315
58	115	316
		320

## Sintering

61
72
74
257
306

## Solidification

5	99
6	206
75	209
87	288

## Strength

<u>Fracture</u>		<u>Super-</u> <u>plasticity</u>	<u>Creep</u>	<u>Flow Stress</u>		
1	246	69	53	1	76	248
57	248	110	69	7	91	252
70	255	293	72	18	92	253
76	268	310	92	19	110	257
207	275		207	23	113	262
231	307		238	36	207	272
			257	51	208	286
			310	53	210	296
			319	55	216	297
			329	67	240	307
				69	242	318
				72	246	323
						324

## Superconductivity

11	35	81	111	232	284
21	36	85	209	236	308
23	45	86	212	239	327
28	77	90	213	241	328
29	80	100	229	266	

## Surface Phenomena and Thin Films

6	34	75	209	232	268	290
11	35	77	212	236	270	295
13	45	85	218	243	282	309
14	55	86	220	244	283	312
24	57	93	224	260	284	316
29	60	106	230	267	289	328

## Void Formation

7	73	228
20	98	230
23	113	271
24	219	323
34	222	

## Electric Field

2	288
5	305
215	309
230	

## Gas

OxidizingHydrogen

20	1	74	258
93	18	76	276
112	26	229	307
224	53	231	321
270	61	256	
294			
295			

## Magnetic Field

4	21	40	102	205	236	258
9	22	52	103	211	237	259
10	28	59	104	212	239	266
11	29	66	114	213	241	279
13	31	82	115	214	243	299
15	32	85	116	218	247	308
16	35	86	203	223	249	309
17	39	90	204	232	251	322
					254	328

## Pressure

Above AtmosphericShock Loading

12	64	261	69
17	96	269	208
18	202	279	310
26	211	281	
59	238	292	
62	254	304	
63	257	326	

## Radiation

<u>Electron</u>	<u>Ion</u>		<u>Neutron</u>		<u>Theory</u>	<u>Gamma</u>
48	24	230	7	113	50	47
68	34	245	23	222	107	115
98	68	264	49	245	271	116
104	73	276	98	252	298	328
105	109	298	102	295		
219	113	300	105	328		
286	228		108			
302						
320						
328						

## Temperature

Below Liquid Helium (4.2°K)High Temperature  
(about 1000°K or higher)

4	52	234	2	112	293
11	65	236	3	206	294
12	81	241	5	209	296
17	83	247	18	216	300
18	86	249	51	222	301
21	89	251	53	230	305
28	90	261	61	240	306
29	205	266	72	250	310
30	212	299	74	257	311
35	213		78	265	314
			79	269	315
			87	270	316
			88	283	317
			89	287	319
			96	288	

~ 20% Neut. scatter + rad. damage

~ 1.7 M for reactor costs

phenomena

~ 11%

strength

4% diffusion

~ 14

radiation

7% supercon

Mat'l

~ 7%

actinides

~ 27%

ceramics

~ 6%

rare earth

