WASH-1181-74

MATERIALS SCIENCES PROGRAMS

FY 1974

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF PHYSICAL RESEARCH

WASH-1181-74
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M A T E R I A L S

S C I E N C E S

P R O G R A M S

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July 1974

UNITED STATES ATOMIC ENERGY COMMISSION

DIVISION OF PHYSICAL RESEARCH

FOREWORD

The Materials Sciences Program constitutes one portion of a wide range of research supported by the AEC Division of Physical Research. Other programs are administered by the Division's Nuclear Sciences, Molecular Sciences, and High Energy Physics Offices. Materials sciences research is supported primarily at AEC National Laboratories and Universities. The research covers a 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 Chemistry.

This report contains a listing of all research underway in FY 1974 together with a convenient index to the program.

Donald K. Stevens
Assistant Director (for
Materials Sciences Program)
Division of Physical Research

INTRODUCTION

The purpose of this report is to provide a convenient compilation and index of the AEC's Materials Sciences Program. This compilation is intended for use by administrators, managers, and scientists to help coordinate research and as an 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 1974 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 Metallurgy and Ceramics (01), Solid State Physics (02), or Materials Chemistry (03). The budget numbers carry the following titles:

01-01 - Structure of Materials
01-02 - Mechanical Properties
01-03 - Physical Properties
01-04 - Radiation Effects

02-01 - Neutron Scattering
02-02 - Experimental Research
02-03 - Theoretical Research
02-04 - Particle-Solid Interactions

03-01 - Chemical Structure
03-02 - Engineering Chemistry
03-03 - High Temperature and Surface Chemistry

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
Materials Sciences Program
Division of Physical Research

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SECTION A - Laboratories

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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 1974.

AMES LABORATORY
Iowa State University
Ames, Iowa 50010
Phone: Area Code 515 284-4000

Metallurgy Division -01-
K. A. Gschneidner - Phone: 294-2272

1. STRUCTURE OF MATERIALS $230,000 01-01
O. N. Carlson, R. K. Trivedi,
F. A. Schmidt

Study of the interaction of interstitial solutes with uranium and the refractory metals (especially vanadium, niobium and molybdenum development of new processes for the production of ultra-pure metals such as those based on electrotransport, electroslag remelting, thermotransport; determination of the intrinsic properties of ultra-high purity refractory metals and the study of the effect of impurities and radiation-produced defects on the physical and mechanical properties of these metals; investigations concerning the structure, energetics, and kinetics of solid surfaces and interfaces using LEED and Auger spectroscopy techniques.

2. MECHANICAL PROPERTIES $ 70,000 01-02
T. E. Scott, O. Hunter, D. T. Peterson

Work concerning the mechanical property-structure relationships for reactor materials including the refractory metals, thorium alloys, HfO_2 and Eu_2O_3; investigation of hydrogen isotope interactions and transport characteristics in CTR first wall candidate materials (V, Nb, and Ta); study of the mechanical and thermal properties of MHD insulating materials (Y_2O_3, ZrO_2, MgO and HfO_2) at temperatures up to 2000°C.

3. PHYSICAL PROPERTIES - THERMODYNAMIC AND ELASTIC PROPERTIES, SUPERCONDUCTIVITY AND MAGNETIC PHENOMENA $431,000 01-03
J. F. Smith, D. M. Bailey, C. W. Chen,
K. A. Gschneidner, Jr., O. D. McMasters,
J. W. Patterson

Magnetic property studies involving NiPt and CoPt compounds in both ordered and disordered states; stacking fault measurements on Nb and Nb-Cr alloys; thermodynamic studies of thorium and uranium oxides and binary thorium alloys; low temperature heat capacity and magnetic susceptibility investigations of α-Ce and β-Ce; superconductivity studies of La-In and La-Al alloys; ionic and electronic conductivity measurements of selected oxides, hydrides, oxyhalides and halides; elastic property studies of vanadium and thorium containing oxygen and carbon respectively.

AMES LABORATORY
Metallurgy Division -01- (Continued)

4. PHYSICAL PROPERTIES - TRANSFORMATIONS, STRUCTURES, AND PHASE EQUILIBRIA — $244,000 — 01-03
P. Chiotti, M. F. Berard, F. X. Kayser, J. D. Verhoeven, D. R. Wilder, D. E. Williams

Sintering, diffusion, and physical property studies of ceramic materials (hafnia, yttria and several rare earth oxides) for use in nuclear and MHD applications at temperatures above 1500°C; production of aligned composite materials and specific microstructure through controlled eutectic solidification and phase transformation; SEM studies of the growth mechanisms of dendritic and precipitate phases; elastic and magnetic property studies of $Fe_3(Al,Si)$ single crystals; neutron diffraction measurements of Fe-Mn-C austenite single crystals.

5. RADIATION EFFECTS — $170,000 — 01-04
M. S. Wechsler, M. F. Berard, C. W. Chen

Radiation damage work involving vanadium-oxygen, nickel-carbon, and thorium alloys; void formation, radiation hardening and radiation-anneal hardening are phenomena which are monitored; interdiffusion studies between Er_2O_3 and HfO_2 and between CaF_2 and YF_3 are being made and will be carried out in other ceramic systems including SrF_2-BaF_2; this work and diffusion investigations involving other refractory oxides is being conducted because of their possible application as LMFBR control materials and models for the study of mixed oxide fuel systems.

Solid State Physics Division -02-
C. A. Swenson - Phone: 294-5442

6. NEUTRON SCATTERING IN SOLIDS — $400,000 — 02-01
S. K. Sinha, C. Stassis, J. G. Traylor, N. J. Chesser, G. R. Kline

Neutron scattering and phonon dispersion relations for the alkali-tungsten-bronze system and Nb-based alloys; spin-wave form factor for Cr-Mn crystals; magnetic structures of Er metal and Y-Er and Lu-Er alloys; magnetic form factors for Er and Ho; structural and dynamical studies of transition metal-hydride systems; inelastic neutron scattering studies of dynamics of molecular crystals and charge-transfer salts; structural and dynamical studies of charge density waves in transition metal chalcogenides.

AMES LABORATORY
Solid State Physics Division -02- (Continued)

7. ELECTRONIC STRUCTURE AND MAGNETIC PROPERTIES OF METALS — $168,000 — 02-02
S. Legvold, S. H. Liu, J. L. Stanford, L. Hodges, B. N. Harmon

Electronic properties of metals and their relationship to magnetic and lattice properties; band structure and Fermi surface calculations of transition metals and their compounds; charge and spin distributions and neutron form factor calculations of transition metals; d-f exchange in rare-earth metals; effects of alloying on the magnetic and electrical properties of α-manganese, transition metals and rare-earth metals; ferromagnetic resonance in $SmCo_5$-type alloys; magnetic excitations in disordered spin systems.

8. NUCLEAR RESONANCE IN SOLIDS — $ 96,000 — 02-02
R. G. Barnes, D. R. Torgeson

Nuclear hyperfine interactions in solids, NMR, NQR, NGR: deuteron and transition metal NMR to characterize lattice sites and to study structural phase transformations and self-diffusion in transition metal hydride and deuteride phases, and to characterize lattice perfection and structural transformations in superconducting intermetallic compounds.

9. SUPERCONDUCTIVITY — $241,000 — 02-02
J. R. Clem, G. C. Danielson, D. K. Finnemore, A. J. Bevolo, B. L. Walton, H. R. Shanks, J. E. Ostenson

Electron tunneling and thermal conductivity in laminar (two-dimensional) superconductors; spin-scattering rates for the Kondo effect and for superconductivity in quench-condensed films; microwave surface impedance studies of vortex nucleation; effects on specific heat and magnetization of attractive interactions between quantized vortices; superconducting transition temperatures near soft-mode crystal structure phase boundaries; Einstein mode specific heat contributions in superconducting non-stoichiometric tungsten bronzes; theory of magnetic structures and magnetic coupling in Type-II superconductors; theory of energy dissipation due to flux motion.

AMES LABORATORY
Solid State Physics Division -02- (Continued)

10. THERMODYNAMIC AND TRANSPORT PROPERTIES OF SOLIDS — $200,000 — 02-02
G. C. Danielson, C. A. Swenson, M. S. Anderson, H. R. Shanks, P. H. Sidles

Pressure-volume-temperature measurements to 20 kbar at temperatures down to 4 K (rare gas solids, hydrogen, deuterium); capacitance dilatometer thermal expansion measurements on potassium, copper and aluminum; basic thermometry from 1 K to 30 K; thermal conductivity at low temperatures of high purity and hydrogen-doped vanadium; filament formation and switching properties of chalcogenide glass; electrical resistivity and switching measurements on RF-sputtered thin film samples.

11. OPTICAL AND SPECTROSCOPIC PROPERTIES OF SOLIDS — $208,000 — 02-02
R. Fuchs, K. L. Kliewer, D. W. Lynch, C. G. Olson

Optical properties (transmission, reflection, thermoreflection) of solids in the vacuum ultraviolet using synchrotron radiation: Au, transition metals, Ge, Si, GaAs, GaSe, LiH; infrared and visible optical properties of metals and alloys; thermomodulation: Al-based alloys, transition metals and alloys, $CaAl_2$; theory of optical properties of surfaces, thin films and particles, including nonlocal effects in optical properties and photoemission, and the effects of surface conditions which characterize solids, such as roughness and surface states; collective excitations in real solids, including phonons, plasmons, and excitons, and their surface counterparts; Compton and Raman scattering.

12. RARE EARTH METALS PREPARATION — $202,000 — 02-02
K. A. Gschneidner, Jr., B. J. Beaudry, P. E. Palmer

Preparation of highly purified rare earth fluorides from the oxides; preparation of single crystals of rare earth fluorides, metals, and special alloys.

AMES LABORATORY
Chemistry Division -03-
J. D. Corbett - Phone: 294-3086

13. X-RAY AND NEUTRON CRYSTALLOGRAPHY $205,000 03-01
R. A. Jacobson, J. E. Benson

Development and extension of x-ray and neutron diffraction techniques; structure determinations in the solid state; structural studies of pesticides, herbicides, hydrides, and materials exhibiting weak solid state interactions.

14. INTERACTIONS IN SOLIDS $ 30,000 03-01
B. C. Gerstein

Magnetic behavior studied by heat capacity, initial susceptibility, EPR and NMR techniques; testing models for interactions in one- and two-dimensions; multiple-pulse NMR studies of chemical shift anisotropies and anisotropic motion in solids.

15. LOWER OXIDATION STATES IN SOLID AND MOLTEN INORGANIC SYSTEMS $130,000 03-01
J. D. Corbett

Synthesis and equilibrium reactions of metallic elements under anaerobic, high temperature, and reducing conditions (e.g., for Sc, Ti, Zr, Hf, Mo, rare earths); structures exhibiting metal-metal bonding, anisotropic conduction; homopolyatomic ions (e.g., of Pb, Bi, Se, Te, I).

16. CHEMISTRY OF HEAVY TRANSITION METALS $ 85,000 03-01
R. E. McCarley

Complexes of Nb, Ta, Mo, W in lower oxidation states; synthesis, characterization and reactions of metal cluster compounds and of others with strong metal-metal bonds; structure and bonding studies by esr, nmr, nqr spectroscopy and x-ray diffraction.

17. SYNTHESIS OF POSSIBLE SUPERCONDUCTORS $ 0 03-01
R. E. McCarley, H. F. Franzen,
J. D. Corbett

Synthesis of compounds showing highly anisotropic electrical conductivity, e.g., rare earth and zirconium subhalides, metal-rich transition metal sulfides, selenides and phosphides; metal cluster compounds containing sulfur and selenium; metal-metal bonded polymers; to start in FY 1975.

AMES LABORATORY
Chemistry Division -03- (Continued)

18. LIQUID METALS $ 85,000 03-02
R. G. Bautista, G. Burnet, M. J. Murtha

Heat content of liquid rare earth metals by levitation calorimetry; measurement and correlation of surface tension and contact angle; purification using solid absorbents; recovery of metals from fly ash using calcination/hydrometallurgical processing.

19. METAL HALIDES $ 55,000 03-02
R. G. Bautista

Decomposition pressures and the heats of decomposition of the dihalides of the platinum group metals by simultaneous torque-Knudsen technique.

20. MASS TRANSFER AND TRANSPORT IN FLUIDS AND PARTICULATE SYSTEMS $100,000 03-02
L. E. Burkhart

Study of particle and fluid motion from numerical solution of the Navier-Stokes equations and fluid flow patterns by high-speed photography; motion and stability of fluids near free surfaces; transport near interfaces and interfacial mass transfer with particular emphasis on drops and bubbles in liquid-liquid systems and liquid metals.

21. HIGH TEMPERATURE CHEMISTRY $130,000 03-03
H. F. Franzen, R. G. Bautista

Structure and bonding in refractory compounds, particularly metal-rich transition metal chalcogenides; high temperature techniques, complete structure determination, phase equilibria; basic optical pyrometry with emphasis on variation in normal spectral emittance with temperature and surface properties.

22. SURFACE CHEMISTRY $140,000 03-03
R. S. Hansen, B. C. Gerstein

Heterogeneous catalysis, with emphases on clean surface techniques such as field emission microscopy, flash desorption spectroscopy, and single crystal face catalysis, and on rare earth oxide catalysts; energy-related catalytic reactions, specifically, hydrogenolysis, water gas shift, and nitric oxide reduction reactions; electrical double layer properties and their alteration by adsorption; mechanical and flow properties of interfaces.

ARGONNE NATIONAL LABORATORY
9700 South Cass Avenue
Argonne, Illinois 60439
Phone: Area Code 312 739-7711

Materials Science Division -01-
B. R. T. Frost - Phone: 739-2221
N. L. Peterson - Phone: 739-2222

23. ALLOY PROPERTIES $450,000 01-01
F. Y. Fradin, A. T. Aldred, D. J. Lam, F. M. Mueller, B. W. Veal, Jr.

Electronic structure of metals with emphasis on actinides, alloy chemistry of binary compounds of Am, magnetic properties of actinide compounds with increasing emphasis on heavier actinides, NMR on actinide compounds, optical reflectivity and x-ray photoelectron studies of actinide metals and compounds, crystal field theory of actinides, x-ray photoelectron and reflectivity studies of transition metals, theoretical calculations of the band structure of actinides and of the electronic structure of Mo with dilute impurities and defects, theory of electron-phonon interactions and superconductivity, magnetism in iron-based alloys, electronic conduction processes and electronic structure of ceramic materials for MHD applications.

24. PHYSICAL METALLURGY $298,000 01-01
M. B. Brodsky, A. J. Arko

Electronic structures of actinide metals, alloys, and compounds, low temperature specific heat measurements, electrical resistivity and magnetic susceptibility of actinide alloys and compounds to study spin fluctuations, electronic lifetimes in palladium containing dissolved actinide metals, de Haas-van Alphen effect in actinide metals and compounds.

25. SCATTERING STUDIES $521,000 01-01
M. H. Mueller, G. H. Lander

Magnetic scattering of neutrons from actinide-based binary compounds with localized moments, inelastic neutron scattering for crystal-field effects in actinides and PrAg, polarized neutron study of actinides plus CeBi and Tb for form factor determination, low temperature x-ray studies to identify distortions from magnetic ordering, magnetic structure at high magnetic fields, crystal structures of palladium and thorium hydrides, defect structures in the ZrO_2-CeO_2 binary system.

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

26. MECHANICAL PROPERTIES $309,000 01-02
U. F. Kocks, E.S.P. Das,
A.P.L. Turner, R. O. Scattergood

Theoretical and experimental research on fundamental aspects of the mechanical properties of metallic and ceramic solids, line tension of dislocations in anisotropic solids, micromechanics of crack nucleation and propagation including ceramic solids, dynamic computer modeling of dislocation motion through individual obstacles and random arrays, work hardening, cyclic hardening and dynamical recovery, constitutive relations for plasticity, creep and fatigue, structure characterization of deformed crystals by x-ray diffraction.

27. METAL PHYSICS $425,000 01-03
N. L. Peterson, W. K. Chen, E. S. Fisher,
M. J. Fluss, N. Q. Lam, J. N. Mundy,
S. J. Rothman, R. W. Siegel,
D. G. Westlake

Atomic mechanisms of self-diffusion and impurity diffusion in solids, effects of hydrogen on physical properties of transition metals, directional dependence of elastic properties, the properties of point-defects and defect clusters using positron annihilation and electron microscopy techniques, self-diffusion in Cr and Nb and the isotope effect, effect of irradiation on diffusion in Ag and Nb, ionic transport mechanisms in solid electrolytes, defect structure and cation diffusion in $Fe_{1-x}O$, Fe_3O_4, and $CoAl_2O_4$, isotope effects and the influence of interstitial impurities on the V-H and Nb-H solvus, interstitial relaxation in V and Nb, studies of point defects in bcc refractory metals, vacancy clustering and vacancy-solute interactions using positron annihilation techniques.

28. SUPERCONDUCTIVITY $189,000 01-03
F. Y. Fradin, G. S. Knapp

Electron-phonon interaction in high-transition-temperature superconductors, NMR and Mössbauer effect studies of the A-15 compounds Nb_3X and V_3X where X is a non-transition element and of the hydrides of Pd and Pd-Sn and Pd-Ag alloys, the effect of magnetic impurities on the critical magnetic field in $LaSn_3$, $LaIn_3$, and $LaPb_3$, anharmonic effects in Nb_3X compounds deduced from heat-capacity studies, x-ray photoemission studies of the band structure of A-15 compounds and superconducting palladium hydrides.

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

29. NEUTRON IRRADIATION $407,000 01-04
T. H. Blewitt, B. S. Brown,
M. A. Kirk, Jr., B. A. Loomis

Point defect production, annihilation and clustering, radiation effects in superconductors, neutron sputtering, flux pinning by defect clusters and voids, particle emission by neutron bombardment, replacement collision sequences, impurity-interstitial interactions and its relation to void formation, void swelling in Nb and Nb-Zr alloys as a function of dose, temperature and oxygen content during simultaneous irradiation with 4 MeV Ni^+ and He^+ ions, radiation sources include the CP-5 low temperature facility and the 4 MeV Dynamitron.

30. CHARGED PARTICLE IRRADIATION $229,000 01-04
K. L. Merkle, R. Benedek, P.P. Pronko

TEM studies of displacement cascades produced by 300 KeV self-ion bombardment and 14 MeV neutron, dechanneling from damage clusters, replactment sequences and long-range diffusion of interstitials, influence of channeling on defect production, resistivity studies of self-ion bombarded thin films, theory of focusing sequences, localized vibrational mode frequencies of self-interstitials, migration and clustering of defects and inert gases, lattice locations of interstitial impurities, impurities, interaction of gas atoms with displacement damage, sputtering due to energetic displacement cascades, theory of grain-boundary structure and diffusion, radiation sources include 300 KeV heavy ion accelerator, 4 MeV Dynamitron, 14 MeV neutron source at LLL and future high voltage electron microscope.

31. KINETIC STUDIES $352,000 01-04
H. Wiedersich, F. V. Nolfi, Jr.,
P. R. Okamoto, A. Taylor

Investigations into forces and mechanisms that lead to the formation of defect aggregates and precipitates and other inhomogeneous distributions of atoms in solids during irradiation, solute segregation to voids and free surfaces during irradiation, effect of irradiations on the microstructure of two-phase alloys - dynamic dissolution and reprecipitation, dimensional changes caused by gas-bubble nucleations, growth and coagulation, stress fields around voids and their interaction with defects and other voids, the effect of fine precipitate dispersions, solute additions, helium, and projectile mass on void formation during ion bombardment, effects of interstitial loop structure and stressed-induced preferred loop orientation on irradiation creep, damage structure produced during high-temperature ion bombardment of oxides, radiation sources include 300 KeV heavy-ion accelerator, 4 MeV Dynamitron, and future high voltage electron microscope.

ARGONNE NATIONAL LABORATORY
Solid State Science Division -02-
D. L. Price - Phone: 739-3141

32. NEUTRON SCATTERING STUDIES $807,000 02-01
T. Brun, G. Felcher, D. L. Price
T. Worlton

Studies are conducted in neutron inelastic scattering, neutron diffraction of magnetic systems and high pressure neutron diffraction, design of a neutron spallation source is underway. The program centers on the CP-5 research reactor; facilities include a thermal neutron time-of-flight spectrometer, triple-axis spectrometer, time-of-flight diffractometer and a two-axis diffractometer. Current studies include diffusion of hydrogen in solid and liquid metals, and the structure of metal hydrides; the dynamics of liquids including rare gas, alkali metal and alloy liquids, liquid salts and He^3-He solutions; the dynamics and structure of amorphous materials (glassy carbon, vitreous BeF_2), molecular reorientation and lattice dynamics of molecular crystals (KCN, NaCN, RbSH, CsSH, NH_4Br); dynamics of superconductors and amorphous metals, crystal field interactions and magnetic effects in rare-earth intermetallics; magnetic scattering in magnetically ordered systems, spin glasses and rare-earth magnetic form factors; high pressure diffraction and compressibility measurements of metals, ionic crystals and ice and their polymorphs.

33. MATERIALS PREPARATION AND CHARACTERIZATION $115,000 02-02
S. Susman, D. Hinks

Activities center on the preparation of research samples of metal, insulator and semiconductor single crystals with documented physical and chemical properties. Materials of current interest include alkali halides and cyanides, rare-earth oxides and hexaborides, rare-earth alloys and rare earths in metallic matrices. Other activities include the preparation of high-purity materials and the development of clean-room facilities and techniques.

34. LOW TEMPERATURE STUDIES $201,000 02-02
H. Culbert, J. Ketterson, P. Roach

Research centers on studies of properties of quantum liquids and solids at very low temperature and the measurement of specific heats of superconducting and magnetic materials at low temperatures. Specific topics include ion and electron motion in ^3He, ^4He and ^3He-^4He solutions; properties of superfluid phases of ^3He; sound propagation in new ^3He phases, development of new materials for adiabatic cooling and low temperature technology, specific heat measurements on Kondo systems (La:Ce); rare-earth sesquioxides displaying antiferromagnetic ordering, and mixed phase alloys (PbNa).

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

35. DEFECTS AND IMPURITIES IN NON-METALLIC SYSTEMS — $290,000 — 02-02
P. Yuster, C. Delbecq, D. Schoemaker, S. Marshall, J. McMillan

Activities include the study of defects and impurities in non-metallic crystals and the processes occuring during and after exposure to ionizing radiation. Emphasis is on determining the nature of the defects and their interaction with host-crystal electronic and lattice modes and with other defects. Current studies include the structure and reorientation dynamics of molecular ion centers (Cl_2^-, $BrCl^-$) in alkali halides, heavy-metal centers in ionic crystals, effect of magnetic fields on recombination luminescence, ESR studies of impurities (Cr^{3+} in MgO, Cu^{2+} in NH_4Cl, Gd^{3+} in YAG) and temperature and magnetic field dependence of spin relaxation times.

36. SUPERCONDUCTIVITY STUDIES — $216,000 — 02-02
R. Huebener, K. Gray

Magnetic structures and transport properties of superconductors are studied using high-resolution magneto-optical techniques, tunnel junctions and electrical noise power measurements. Topics of current interest are the dynamic behavior of flux structures, relaxation time for magnetic flux penetration, electrical and magnetic properties and superconductivity breakdown at very high transport currents, the influence of light on superconductivity, properties of magnetically-coupled superconducting films, flux flow and flux pinning in high-Tc superconductors.

37. ELECTRONIC AND MAGNETIC PROPERTIES — $264,000 — 02-02
B. Dunlap, J. Ketterson, L. Windmiller, G. Crabtree

Activities include studies of the Fermi surface in metals and alloys and the use of the Mössbauer effect to study the magnetic properties and electronic structure of lanthanides and actinides. Current studies include the magnetic properties of neptunium intermetallics, the neptunium monopnictides and Np Laves-phase compounds as well as Yb intermetallics; de Haas-van Alphen studies of the Fermi surface in Au and Au-Ga alloys, Pt and Pd and their alloys with Fe, Co and Ni; band calculations in Tc and Mo, and the scattering of conduction electrons by impurities, lattice defects and local moments in metals.

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

38. PHASE TRANSITIONS AND CRITICAL PHENOMENA $205,000 02-02
L. Guttman, H. Kierstead, D. O'Reilly

Research is devoted to studies of phase transitions in order-disorder systems, liquid helium, ferro- and antiferroelectrics and the dynamics of molecules in liquids and glasses and the structure of glassy materials. Experimental techniques include x-ray scattering, ESR, NMR, and studies of PVT diagrams. Areas of current emphasis include the thermodynamic properties of ^{3}He-^{4}He mixtures near the tricritical point, scaling laws, higher-order phase transitions and critical ordering in alloys (Fe_3Al), computer modeling of glasses and liquids, magnetic resonance studies of phase transitions in acetylene, phosphoric acid glass and of self-diffusion in liquids, as well as magnetic resonance studies of surface states, diffusion of adsorbed species and surfaces and catalysis.

39. SOLID STATE THEORY $384,000 02-03
T. Arai, T. Gilbert, D. Koelling, O. C. Simpson, F. Mueller, A. Rahman, J. Robinson, D. Smith

A broad range theoretical program emphasizing interaction with experimental groups. Areas of activity include: electron correlation at metallic densities, itinerant theory of magnetism and electron correlations, electron-hole plasmas, hydrogen in metals, defects in metals and insulators, temperature dependence of magnetic ordering in rare-earth metals and alloys, localized moments and the Kondo effect, cumulant perturbation expansion for spins, molecular dynamics calculations, theory of neutron scattering measurements, vortex motion in quantum liquids, electron-phonon interactions, structure and interactions of atoms in molecules and solids, optical and electronic properties of insulators, electronic structure and properties of metals, actinide metals and intermetallic compounds, superconductivity and superfluidity, and the magnetism of transition metal alloys.

40. ENERGETIC PARTICLE INTERACTION $268,000 02-04
J. Jackson, W. Primak, P. Vashishta

A program devoted to radiation damage by ions, electrons and neutrons in metals and insulators and to the elementary defects produced in these materials. Topics of current interest in metal physics include elementary defects and their interactions, defect production and trapping rates, distribution of defects, properties of divacancies and larger cluster impurity effects, deviations from Matthiessen's rule, theoretical studies of defect formation and migration in metals. Radiation damage in insulators includes work on lithium niobate, sapphire, spinel, lucalox, barium titinate and glasses; topics studied involve optical and electrical effects, dimensional changes, stress formation and relief, surface destruction, blister formation and spallation.

ARGONNE NATIONAL LABORATORY
Chemistry Division -03-
P. R. Fields - Phone: 739-2666

41. NEUTRON DIFFRACTION STUDIES $386,000 03-01
S. W. Peterson, J. M. Williams
H. E. Flotow, M. Atoji

Neutron studies of structure and bonding in highly conducting materials such as the Krogmann salt, $K_2Pt(CN)_4Br_{0.3} \cdot 3H_2O$; the asymmetric bifluoride ion; the $H_9O_4^+$ ion and inversion disorder in $H_2PtCl_6 \cdot 6H_2O$; metal and organometallic cluster hydride complexes; the Schwinger effect in neutron scattering.

Study of the scattering of neutrons by hydrogen isotopes in metals to obtain information relating to diffusion, phase changes and lattice dynamics; effects of tritium and ^3He in Nb for CTR first-wall containment evaluation; diffusion of hydrogen in a single crystal of Ta; lattice dynamics study of PdD_x and NbD_x.

Neutron diffraction studies of the magnetic-moment and magnetic-domain structures of rare-earth metal single crystals (Tb, Dy, Er and Tm) at 2-300°K with emphasis on the external magnetic-field effect; magnetic and/or crystal structure investigations on rare-earth alloys and compounds as well as on the energy-program related subjects, e.g., EuC_2, UMn_2, cubic sodium tungsten bronzes and Tl_2O; interpretive work on the magnetic properties of rare-earth carbides and the $MoSi_2$-type compounds based on neutron diffraction results and on phenomenological theories.

42. X-RAY DIFFRACTION STUDIES IN ENERGY PROGRAMS $111,000 03-01
S. Siegel and E. G. Sherry

Structural studies of fission product compounds formed during reactor irradiation of fuels; x-ray diffraction investigations of electrode changes under varying charge conditions in connection with the high-power-density battery development program; crystallographic investigations of piezoelectric sensing devices for LMFBR; x-ray diffraction studies of actinide compounds.

ARGONNE NATIONAL LABORATORY
Chemistry Division -03- (Continued)

43. INORGANIC CHEMISTRY OF URANIUM — $ 58,000 — 03-03
H. R. Hoekstra

Studies of uranium compounds of interest to the atomic energy program; hydrothermal studies on the Y_2O_3-UO_3-H_2O system; calorimetric measurements on alkali metal uranates; x-ray and infrared studies of α- and β-U_3O_8; studies of fission product compounds.

44. HIGH TEMPERATURE CHEMISTRY — $304,000 — 03-03
R. J. Thorn, R. J. Ackermann, J. R. McCreary, E. G. Rauh, G. H. Winslow

Partial molar entropies and enthalpies of sublimation and vaporization of inorganic materials; thermochemical systematics of lanthanide and actinide compounds; high temperature mass-spectrometry; high temperature x-ray diffraction for phase transformations and expansions; photoelectron spectrometry; lattice defects and valence states causing nonstoichiometry and accompanying atomic and electrical transport, plastic deformation and sintering; role of excited states in bonding in high temperature molecules and refractory solids; basic thermodynamics, including statistical, of valence states; entropy-energy relations; and equations of state of nonstoichiometric materials.

45. SPECTROSCOPY OF HIGH TEMPERATURE SYSTEMS — $241,000 — 03-03
D. M. Gruen, R. L. McBeth, I. Sheft

Studies of the chemical effects of energetic reactive ion bombardment of solids; chemical sputtering of metals and insulators; matrix isolation spectroscopic identification of sputtered atoms and molecules; vibrational spectra of deuterium implanted oxides; lattice modes of anodic films; U.V., I.R., laser Raman, ESCA and x-ray diffraction studies of ion bombarded surfaces; photon absorption of doped deuterium matrices; direct synthesis of transition metal-π arene sandwich compounds in noble gas matrices.

46. LOW TEMPERATURE CALORIMETRY — $ 91,000 — 03-03
D. W. Osborne and H. E. Flotow

Heat capacity measurements and determination of entropies, enthalpies, and Gibbs energies from 0.1 to 350°K for compounds relevant to the LMFBR (e.g., plutonium and uranium oxides and sodium uranates), fission products (e.g., Cs_2UO_4 and Cs_2MoO_4), advanced reactor fuels (e.g., U_3Si, plutonium carbides and plutonium nitrides), CTR (e.g., Li_3N), and compounds involved in possible cycles for the thermochemical decomposition of water.

ARGONNE NATIONAL LABORATORY
Chemical Engineering Division -03-
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47. LIQUID METALS CHEMISTRY $160,000 03-02
V. Maroni, E. Veleckis,
M. Blander, M. Saboungi

Thermodynamic and transport properties of liquid alkali metals and their solutions pertinent to the advancement and understanding of chemistry for fusion and fission reactor technology and for lithium metal sulfide battery development; phase diagrams and solution thermodynamics of Li-H_2, Li-D_2, Li-T_2, Li-N_2 systems by tensimetric methods, thermal analysis and filtration techniques; distribution of tritium between lithium and molten salts; electrochemical methods for tritium and deuterium recovery from molten salt solutions; diffusion coefficients of hydrogen and deuterium in liquid Li, Na, and NaK as a function of temperature, effect of oxygen, carbon and nitrogen impurities on interactions of lithium with refractory metals and Nb-Zr and V-Ti alloys; binary interaction chemistry of nitrogen and carbon contaminants in liquid sodium; thermodynamic properties of alloys of active metals such as Li, Na and Al that may be useful as electrodes in batteries; emf studies of Li-Mg, Li-Zn, Li-Al-Mg, Li-Bi, Li-Pb, Na-Al, Na-Mg.

48. ATMOSPHERIC PARTICLE CHEMISTRY AND SULFUR-EMISSION CONTROL STUDIES $130,000 03-02
P. T. Cunningham, W. Hubble

Chemistry of airborne particulates; sulfur dioxide emission control chemistry; development of methodology for particulate characterization; particulate formation mechanisms; evaluation of particulate control methodologies; size, time, and spatial variations in the chemistry of airborne particulates in Chicago, St. Louis, and Riverside, California; infra-red spectroscopy, application to determining the distribution and concentration of carbonate, silica, silicate, nitrate, sulfate, ammonium, hydrocarbon, etc. in particulates; laboratory simulation of atmospheric conditions for the study of sulfate and nitrate particle formation; evaluation of various sulfate and nitrate formation mechanisms; kinetics of sulfur fixation by half-calcined dolomite and of the regeneration of the active material from sulfated calcine, mechanism of reactions, evaluation of half-calcined dolomite as a SO_2-control method.

ARGONNE NATIONAL LABORATORY
Chemical Engineering Division -03- (Continued)

49. MOLTEN SALT CHEMISTRY $132,000 03-02
M. Blander, H. M. Feder,
M. Saboungi, G. Papatheodorou

Calculation of phase diagrams and other thermodynamic properties of molten salts using fundamental solution theories; conformal ionic solution theory; liquidus diagrams of ternary molten salt systems with binary compounds and solid solutions, statistical mechanics of ionic systems; laser Raman spectral studies of organic materials in molten salts, spectra of poly alcohols in NaSCN-KSCN eutectic, structure of species in solution, reaction mechanisms in fused salt media. New electrolyte systems for high-energy storage batteries, synthesis of tetra-aryl substituted borohydrides of lithium and sodium; properties (electrical conductivity, thermal stability, reduction stability, eutectic temperatures with alkali halides) of synthesized borohydrides.

50. PHYSICAL CHEMISTRY OF ALKALI METAL-SULFIDE BATTERY SYSTEMS $ 0 03-02
R. K. Steunenberg, J. R. Selman,
A. E. Martin

Electrochemical and phase studies of cathode materials in lithium-aluminum/LiCl-KCl/metal sulfide batteries; electrode reaction kinetics and mechanisms, thermodynamics of Li-Al alloys by emf methods, exchange-current measurements, chronopotentiometry, Li diffusion in solid LiAl, phase studies of ternary (FeS_2-Fe-Li_2S, Cu_2S-Cu-Li_2S) and quaternary (FeS_2-Fe-Li_2S-K_2S, FeS_2-Fe-Li_2S-Ni) systems, x-ray and ion-microprobe examination of phases, synthesis of new complex sulfide electrode materials. To start in FY 1975.

51. PHYSICAL PROPERTIES OF GASES $ 80,000 03-02
M. Blander, T. Renner, H. M. Feder

Thermophysical properties of associating and chemically reacting gases potentially useful as heat transfer fluids, thermal conductivities and equilibrium constants for vapor species in simple alcohols, halogenated alcohols, perfluorinated methyl hydrazines, P-V-T measurements, Mollier diagrams, non-empirical intermolecular pair potential construction method for calculation of physicochemical properties of rare gases and selected diatomic gases such as diatomic helium.

ARGONNE NATIONAL LABORATORY
Chemical Engineering Division -03- (Continued)

52. THERMODYNAMIC PROPERTIES OF INORGANIC SUBSTANCES — $245,000 — 03-02
P. A. G. O'Hare, W. N. Hubbard, G. K. Johnson, M. Ader, D. R. Fredrickson

Experimental and computed thermodynamic data on nuclear and non-nuclear energy related materials; oxide, carbide and nitride fuel materials, fuel-cladding and fission-product-cladding interaction compounds, coolant-structural material interaction compounds for fusion and fission reactors; Li/S battery-related and coal-fired MHD related compounds; standard enthalpies of formation ($\Delta H^\circ_{f(298)}$), high temperature enthalpy increments ($H^\circ_T - H^\circ_{298}$); electron affinity, dissociation enthalpy, ionization potential, spectroscopic constants, electric dipole moments of diatomic systems; oxygen and fluorine bomb calorimetry, hypergolic reaction calorimetry, flow calorimetry, drop calorimetry to 2500 K; enthalpies of formation of $Cs_2U_2O_7$, Cs_3CrO_4, $Cs_{4\pm x}CrO_4$, Fe_2CrO_4, $NaVO_2$, Pu_2O_3, $US_{1.9}$, US_3, FeS_2, WS_2, $CsAlO_2$, $KAlO_2$, TiS, $Ti_4C_2S_2$, (UC, ZrC), VF_3, LiAl, Li_3Al_2; high temperature enthalpies of Li_3N, Cs_2UO_4, $Cs_2Mo_2O_7$, α-Na_2UO_4, $LiAlO_2$; electron affinity, stability and ionization potential of KO^-, PO, PO^-, NF, OF and TeF.

53. BUBBLE NUCLEATION — $ 40,000 — 03-02
M. Blander and Hann-Shen Huang

Homogenous and heterogenous bubble nucleation and explosive boiling studies; properties (densities and compressibilities) of metastable fluids and testing of equations of state, contact vapor explosion mechanisms, nucleation theory, technique development for limit of superheat measurements, superheat limits for hydrocarbons, and for water-molten salt systems, water-salt mutual solubility relationship to explosive boiling of water.

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

54. PHYSICAL PROPERTIES: SUPERCONDUCTIVITY — $217,000 — 01-03
M. Strongin, A. Sweedler, O. Kammerer, M. Suenaga, T. Luhman, D. Miller, C. Varmazis, M. Yu

Properties of superconductors - thin films, their critical temperature, surface and nucleation studies; search for excitonic mechanism for superconductivity; penetration depth measurements; niobium cavities, microstructural and impurity effects on rf breakdown using LEED and Auger spectroscopy; electron beam, and sputtering evaporation and other techniques for preparation of high T_c materials; neutron and x-ray diffraction of superconductors; specific heat measurements of A-15 compounds - single crystal preparation of A-15 compounds.

55. PHYSICAL PROPERTIES: RELATIONSHIP BETWEEN PROPERTIES AND STRUCTURE — $218,000 — 01-03
M. Suenaga, T. Luhman, C. Klamut

Development, fabrication, and evaluation of high critical current, high magnetic field and high T_c A-15 superconducting multifilamentary wires and reinforced conductors for high field magnets; kinetics and mechanisms of formation of A-15 superconductors; flux pinning mechanism in A-15 compounds; preparation of and ac losses at 60 Hz in A-15 tape conductors for power transmission; evaluation of new techniques for preparation of A-15 conductors.

56. RADIATION EFFECTS — $ 85,000 — 01-04
L. Snead, A. Sweedler, D. Schweitzer

Study of the effects of radiation (electrons, protons, neutrons, gamma) on the properties of superconducting materials and conductors at room and cryogenic temperatures - materials are type I, II and A-15 compounds; specific heat, x-ray and neutron measurements for martensite transition and degree of order; also behavior on annealing, magneto-resistance and resistivity changes post-irradiation.

BROOKHAVEN NATIONAL LABORATORY
Physics Department -02-
B. C. Frazer - Phone: 345-3876

57. NEUTRON SCATTERING - MAGNETIC SYSTEMS $485,000 02-01
G. Shirane, L. Passell, D. E. Cox and Y. Endoh

Neutron scattering studies on the structure and dynamics of spin systems in magnetic materials. Spin waves and exchange constants for EuO and EuS. Spin dynamics in one-dimensional systems: antiferro-magnetic chains in copper dipyridine chloride and ferromagnetic chains in $RbFeCl_3$. Spin waves in an FeMn alloy. One-dimensional magnetic order in $RbFeBr_3$. Preparation and properties $Ba_2MM'O_6$ magnetic materials. Magnetic structure of $ErAl_3$. Magnetic form factor for Fe at small Q.

58. NEUTRON SCATTERING - PHASE TRANSITIONS $439,000 02-01
G. Shirane, J. D. Axe, J. K. Kjems, S. M. Shapiro, and Y. Fujii

Neutron scattering studies of structural rearrangements and of dynamical fluctuations in ordering parameters associated with phase transitions in non-magnetic systems. Influence of energy gap on phonon line widths in strong-coupled superconductors. Cooperative Jahn-Teller transitions in $PrAlO_3$. The central peak problem in soft phonon driven phase transitions - the case of $LaAlO_3$. Soft modes in the $CsPbCl_3$ phase transitions. Dynamical critical phenomena in ND_4Br.

59. NEUTRON SCATTERING - ELEMENTARY EXCITATIONS IN SOLIDS $365,000 02-01
G. Shirane, J. D. Axe, L. Passell, Y. Endoh, J. Skalyo, Jr., and J. K. Kjems

Neutron spectroscopy of low-lying thermally excited energy states in solids. Phonon dispersion relations for solidified krypton and xenon. Lattice excitations in the solid phases of He-4. Crystalline electric fields in rare-earth pnictides. Lattice dynamics of Zn. Development of improved techniques, experimental and analytical, for inelastic neutron scattering studies.

BROOKHAVEN NATIONAL LABORATORY
Physics Department -02- (Continued)

60. NEUTRON SCATTERING - PARTIALLY ORDERED SYSTEMS — $287,000 — 02-01
G. Shirane, J. D. Axe, L. Passell, R. Pynn, J. K. Kjems, H. Taub

Neutron scattering studies of short-range positional correlations and of both collective and localized excitations in liquids, amorphous solids, dense gases, and certain thin films and surfaces. Collective excitations in superfluid helium. Static correlations in nematic liquid crystals. Neutron diffraction studies of adsorbed nitrogen films on graphite.

61. EXPERIMENTAL RESEARCH - SUPERCONDUCTIVITY — $130,000 — 02-02
M. Strongin, J. E. Crow, M. Yu

Superconducting properties of thin films and small particles, and the effects of surface conditions on the properties of superconductors. Investigations on the influence of magnetic scattering on superconducting properties. The effect of crystallographic order on critical temperatures. Superconducting properties of ultra-thin films in contact with semi-conductor surfaces. Oxygen segregation to surface in Nb and relationship with rf superconducting properties. Work on magnetism and superconductivity with investigation of crystalline electric fields in superconductors and their influence on magnetic ground states of impurities.

62. EXPERIMENTAL RESEARCH - LOW TEMPERATURE PHYSICS — $148,000 — 02-02
V. J. Emery, T. A. Kitchens, E. B. Osgood, W. C. Thomlinson

Principal emphasis on properties of condensed phases of helium. Lattice dynamics of the He-4 solid phases. Superfluidity in He-3. Research on transport properties, particularly in magnetic systems, with chief interest in critical phenomena.

BROOKHAVEN NATIONAL LABORATORY
Physics Department -02- (Continued)

63. THEORETICAL RESEARCH — $402,000 — 02-03
M. Blume, G. J. Dienes,
V. J. Emery, R. E. Watson,
D. O. Welch, S. Krinsky,
D. Mukamel, K. Murata

Theory of phase transitions and critical phenomena, magnetism, liquid helium (He-3, He-4, and their mixtures), ferroelectricity, electronic structure of metals and alloys, and crystal defect physics. Ising model for tricritical points in ternary liquids. Variational approximation to a ferromagnet in a magnetic field. Staggered magnetic fields in antiferromagnets. Computer studies of spin and energy transport in one-dimensional Heisenberg magnets. Superfluidity in liquid He-3. Analysis of soft x-ray photoemission data from alloys. Dynamics and kinetics of crowdion interactions. Defect-defect interactions and phase transitions. Studies of valence electron distributions in crystals. Mössbauer and spin resonance line shapes and perturbed angular correlations in randomly varying external fields.

64. PARTICLE-SOLID INTERACTIONS - RADIATION EFFECTS — $370,000 — 02-04
A. N. Goland, D. T. Keating,
P. W. Levy, N. Carrera,
F. H. Geisler, K. J. Swyler

Defect studies employing positron annihilation lifetime and Doppler-broadening measurements on irradiated samples. Simultaneous optical absorption and luminescence measurements during electron or gamma-ray irradiation of LiF. Electron irradiation studies of metals preirradiated with 14 MeV neutrons. Effects of radiation on thermal decomposition and color center formation in ammonium perchlorate. Properties and applications of charged-particle tracks in dielectrics. Calculations of x-ray scattering from graphite crystals containing defects. Calculation of damage energy cross sections and primary recoil spectra for CTR-related neutron sources.

BROOKHAVEN NATIONAL LABORATORY
Physics Department -02- (Continued)

65. PARTICLE-SOLID INTERACTIONS - PROPERTIES OF IMPERFECT SOLIDS — $360,000 — 02-04
A. N. Goland, D. T. Keating, P. W. Levy, F. H. Geisler, J. Golovchenko

Investigations on the properties of non-ideal materials and studies utilizing particle-solid interactions as diagnostic probes in solid state research. Studies of equilibrium properties of crystal defects by positron annihilation lifetime and Doppler broadening measurements. X-ray and neutron scattering studies of the omega phase transformation in zirconium-niobium alloys. Channeling investigations of charge-exchange in thin Au crystals. Stopping power calculations for channeled particles. Diffraction studies of anharmonicity, bonding electrons and impurity locations.

Department of Chemistry -03-
G. Friedlander - Phone: 345-4301

66. NEUTRON SCATTERING STUDIES — $401,000 — 03-01
L. Corliss, J. Hastings, W. Kunnmann, F. Mustoe

Neutron scattering studies of Dysprosium Aluminum Garnet (DAG) in the critical region and in the vicinity of the tri-critical point; production and characterization of "staggered" magnetic fields in fully compensated antiferromagnetics with the rutile structure; magnetic structure studies of the $FeTaO_4$-$FeWO_4$ system; critical-point behavior of magnetite.

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

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

67. SOLID STATE PHASE TRANSFORMATIONS AND THIN FILMS — $108,000 — 01-01
C. Marvin Wayman

Phase transformations in bulk alloys and thin films; emphasis on growth modes of thin films, martensite, ordering and amorphous-to-crystalline transitions; body centered cubic metals, nickel-aluminum alloys and metal hydrides are being studied.

68. ELECTRONIC STRUCTURE AND MAGNETISM OF TRANSITION METAL ALLOYS — $ 44,000 — 01-01
P. A. Beck

Magnetic properties of alloys of the 3d transition metals; emphasis on the effect of ordering and mictomagnetism; alloys studied include Re-Co solid solutions, Cr-Fe alloys and Cr-Fe-Al alloys.

69. DEFORMATION OF INTERMETALLIC COMPOUNDS AT ELEVATED TEMPERATURES — $ 20,000 — 01-02
H. L. Fraser

High temperature mechanical properties of intermetallic compounds (NiAl) are being examined; determination of the morphology of hydride precipitates in niobium and dislocation behavior during their formation.

70. POINT DEFECT - DISLOCATION INTERACTIONS — $116,000 — 01-02
H. K. Birnbaum

The diffusion of hydrogen in body centered cubic metals like iron and niobium is measured over a temperature range from 4°K to 2000°K.

71. DEFORMATION OF REINFORCED METALS — $ 22,000 — 01-02
M. Metzger

Mechanical microstrain and dislocations are examined in composite materials to develop realistic models capable of predicting the behavior of these systems under stress.

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

72. THE MECHANISM OF STRESS-CORROSION CRACKING — $ 69,000 — 01-02
E. N. Pugh

Stress corrosion cracking of aluminum-magnesium alloys; emphasis on the mechanism of crack propagation which is investigated by acoustic emission techniques.

73. PRECIPITATION IN REFRACTORY METAL ALLOYS — $ 40,000 — 01-02
C. A. Wert

Multicomponent alloys of hydrogen, oxygen, nitrogen and carbon with refractory metals like vanadium and tantalum are being studied with attention to solubilities, aging characteristics, precipitation, tensile strength and hardness.

74. INTERSTITIAL SOLID SOLUTIONS — $ 58,000 — 01-03
C. J. Altstetter

This program is concerned with the state of interstitial solute atoms in metals, their solubility, the precipitates which form, and the effect on the mechanical properties; feasibility of electrolytic protection of refractory metals against oxidation.

75. NUCLEAR MAGNETIC RESONANCE STUDIES — $ 58,000 — 01-03
T. J. Rowland

Nuclear magnetic resonance and field ion microscopy techniques are used to study solutions of hydrogen in niobium, precipitation in copper-beryllium alloys, and molecular relaxation in polymers.

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

76. ANHARMONIC EFFECTS IN SOLIDS — $ 93,000 — 02-02
A. V. Granato

The non-linear elastic properties of materials are studied by ultrasonic techniques; applications to thermal transport properties, martensitic and perovskite structure phase transitions and the mechanical strength of superconductors.

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

77. USE OF VERY HIGH PRESSURE TO INVESTIGATE THE STRUCTURE OF MATTER — $137,000 — 02-02
H. G. Drickamer

Electronic transitions in rare earths; oxidation state of transition metals like iron; changes in spin state under very high pressure are investigated through luminescence, optical absorption, x-ray diffraction and Mössbauer techniques.

78. DEFECT AND ELECTRONIC PROPERTIES OF SOLIDS — $108,000 — 02-02
D. Lazarus

The atomic mechanism responsible for mass, charge and thermal transport in solids; thermoelectric power of alkali metals; effect of pressure on the high temperature thermoelectric power of common thermocouple materials; atomic diffusion in refractory metals.

79. PROPERTIES OF NOBLE GAS CRYSTALS — $ 66,000 — 02-02
R. O. Simmons

The lattice dynamics and defect structure of noble gas and molecular crystals are investigated by x-ray and optical scattering.

80. NUCLEAR MAGNETIC RESONANCE IN SOLIDS — $160,000 — 02-02
C. P. Slichter

Magnetic systems are studied by nuclear magnetic resonance; systems under investigation include alloys of transition metals with copper, aluminum and silver; spin susceptibility of conduction electrons in potassium and charge density oscillations in this metal.

81. PHYSICS OF REFRACTORY MATERIALS — $ 86,000 — 02-02
W. S. Williams

The thermal, mechanical and electrical properties of the transition metal carbides.

82. RADIATION DAMAGE IN SOLIDS — $125,000 — 02-04
J. S. Koehler

Electron diffraction, diffuse x-ray scattering and anomalous x-ray transmission techniques are used to determine the geometrical structure of interstitial atoms, vacancies and clusters of these defects in radiation damaged metals and semiconductors; mechanisms of annealing of these defects are also studied.

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Inorganic Materials Research Division
L. Brewer - Phone: 642-5176
V. Zackay - Phone: 642-3812
R. Muller - Phone: 843-6079

83. POWDER METALLURGY — $100,000 — 01-01
M. R. Pickus

There are important problems related to improved energy conversion systems and to the need for reducing environmental pollutants, the solutions for which depend on the availability of appropriate materials. This program is concerned with research on selected aspects of the powder metallurgy process that are uniquely suited for the development of such materials. The program will have two principal facets: A basic study of the conditions required for effective consolidation of powders into useful materials; and an effort specifically oriented toward the design of the special types of materials required to cope with these problems.

84. MICROSTRUCTURE, PROPERTIES AND ALLOY DESIGN: ELECTRON DIFFRACTION AND MICROSCOPY — $220,000 — 01-01
G. Thomas

The investigation of the relationship between microstructure and properties; control of properties through characterization and control of structure; application of principles of strengthening, and phase transformations, to economical alloy design. Structural investigations are carried out mainly by electron microscopy and x-ray analysis. Systems under investigation include structural alloy steels, alloys undergoing spinodal and ordering transformations, oxide systems. In steels, interest is in controlling the transformation substructure and properties of martensites and bainites. In ferrites, interest is in defining the defect chemistry and searching for spinodal systems so as to control microstructure for control of properties. In order to obtain maximum information and quantitative characterization of materials basic work on electron scattering and contrast is continuing, including applications of the "critical voltage phenomenon" in high voltage E. M. to compositional variations in alloys.

LAWRENCE BERKELEY LABORATORY
Inorganic Materials Research Division (Continued)

85. FUNDAMENTALS OF ALLOY DESIGN $390,000 01-02
V. F. Zackay, E. R. Parker

Design of alloys for advanced energy conversion systems. The problem areas are being identified in several ways, including an extensive perusal of the literature and by visits-in-depth of the various laboratories which are involved in the science and engineering of advanced energy conversion systems. A materials need will be defined in terms of the properties that are required. Alternate approaches to the composition and structure required for those properties (both bulk and surface) will then be formulated. Unconventional methods of fabrication, if needed, will be explored to produce the required alloy. This might include one of such widely varying techniques as fluidized bed methods of coating particles followed by conventional powder metallurgy consolidation techniques. Graded composites, whose composition and structures vary with depth, can be produced by directional solidification, or by unique powder metallurgy processes.

86. CRYSTAL IMPERFECTIONS IN DAMAGED, ION IMPLANTED AND SOLID STATE ELECTRONIC MATERIALS $185,000 01-02
J. Washburn

Experimental investigations are aimed at improvement of knowledge concerning the nature and behavior of point, line, and area defects in crystals and the ways in which they affect important phenomena such as radiation damage, plastic deformation, fracture, and electrical properties.

87. THEORETICAL PROBLEMS IN ALLOY DESIGN $140,000 01-02
J. W. Morris, Jr.

Theoretical problems in the design of new alloys to meet engineering needs; the information theoretically required to follow this design sequence can be roughly divided into four areas: (1) thermodynamics of alloys; (2) correlation of microstructure to processing; (3) correlation of mechanical properties to microstructure; (4) methods of synthesizing this information in the selection of alloy composition and processing. Current research tasks in this program address each of these four areas. The overall program is now oriented toward the key metallurgical problem of devising new alloy concepts leading to materials combining high strength with high toughness. This research has led to a body of new theoretical results and to a series of new techniques for toughening ferritic steels for cryogenic use.

LAWRENCE BERKELEY LABORATORY
Inorganic Materials Research Division (Continued)

88. HIGH TEMPERATURE REACTIONS $145,000 01-03
A. W. Searcy

The principal objectives of the program are to elucidate the equilibria and kinetics for vaporization and decomposition reactions at high temperatures. Primary emphasis is placed on experimental and theoretical study of evaporation reactions at solid-gas interfaces. Mass spectrometers are used to identify the vapor species, and mass spectrometer and torsion effusion apparatuses are used to measure rates of vaporization and thermodynamic stabilities. The deflection of beams in an inhomogeneous magnetic field is being used to study energy states and the degree of excitation of molecules during sublimation. The fundamental concepts of surface and solution thermodynamics are being re-examined.

89. SUPERCONDUCTIVITY EFFECTS - HIGH FIELD SUPERCONDUCTIVITY $ 75,000 01-03
M. R. Pickus

All of the superior high field superconductors are brittle intermetallic compounds, inherently difficult to fabricate into useful forms. The objective of this project is to develop special materials processing systems for these materials. The experimental approach is to use powder metallurgy to produce composites consisting of thin filaments of the brittle superconducting phase dispersed in a ductile matrix.

90. COMPOSITE MATERIALS AND THEIR ELECTRICAL MAGNETIC AND MECHANICAL PROPERTIES $120,000 01-03
R. H. Bragg

Investigation of the electrical, magnetic and mechanical properties of composite materials having unique controlled microstructures. Both ceramic (Vitreous or Glassy Carbon) and metallic systems (Al-$CuAl_2$ and Al-Si eutectics) are being studied in order to obtain a correlation between microstructure and electronic and mechanical properties. Some of the unusual features of Glassy Carbons are their electronic behavior which resembles small band gap amorphous semiconductors, the large closed pore volume not found in other carbons or graphites, and the high resistance to oxidation or thermally induced microstructural changes. The unidirectionally solidified eutectics, are well known for their growth induced anisotropy in many physical properties.

LAWRENCE BERKELEY LABORATORY
Inorganic Materials Research Division (Continued)

91. MICROSTRUCTURE AND MECHANICAL BEHAVIOR OF CERAMIC MATERIALS; GLASS- AND CERAMIC-METAL SYSTEMS — $160,000 — 01-03
J. A. Pask

The research program is concerned with developing (1) a fundamental understanding of solid state chemistry factors (e.g. diffusion mechanisms and kinetics, high temperature reactions, distribution of phases) responsible for the realization of controlled microstructures of ceramic materials; (2) the relationship of character of a ceramic material (single crystal or polycrystalline) to its mechanical behavior at room and elevated temperatures; and (3) a structural, thermodynamic and electrochemical understanding of reactions at glass-metal and ceramic-metal interfaces.

92. RELATION OF MICROSTRUCTURE TO PROPERTIES IN CERAMICS — $130,000 — 01-03
R. M. Fulrath

This program emphasizes the importance of processing in determining properties of structural, piezoelectric, ferroelectric, and ferromagnetic ceramics. Studies include processing parameter control to develop specific defect structures in electronic ceramics, the development of better theories to guide the sintering of powdered metals and ceramics, and fracture mechanisms in brittle materials.

93. RESEARCH ON SUPERCONDUCTORS, SUPERCONDUCTING DEVICES, AND NOISE — $105,000 — 02-02
J. Clarke

Origins of 1/f noise or flicker noise in a wide variety of systems; theory of 1/f noise is now being applied to thin metal films, colloidal suspensions, fluids near their critical point, superconductors, Josephson junctions, and semiconductors; relaxation processes in a superconductor that has been driven into non-equilibrium by a normal current; dilution refrigerator is being used to determine the superconducting transitions temperature of metals even when this temperature is far below the temperature of the experiment; a second application of the refrigerator is to the study of superconductivity in highly doped degenerate semiconductors; developing stable and reliable thin film niobium SQUIDS for the measurement of very small voltages, magnetic fields, and field gradients; aim is to produce a highly reliable yet sensitive instrument for field use; Josephson junction bolometers for use in the detection of far-infrared radiation.

LAWRENCE BERKELEY LABORATORY
Inorganic Materials Research Division (Continued)

94. FAR INFRARED SPECTROSCOPY $ 90,000 02-02
P. L. Richards

The primary object of this project is far-infrared spectroscopy in frequency range from 2-500 cm^{-1}. Experimental techniques include Fourier spectroscopy, lasers, Fabry-Perot interferometers, and cryogenic detectors. Systems under study include Josephson currents in superconducting tunnel junctions, difference frequency generation and nonlinear spectroscopy using dye lasers, resonant modes in insulating antiferromagnets and Mn-doped Al_2O_3, and balloon-borne experiments to measure the cosmic background radiation (in collaboration with the NASA-sponsored Space Science Laboratory).

95. EXPERIMENTAL SOLID STATE PHYSICS AND QUANTUM ELECTRONICS $135,000 02-02
Y. R. Shen

Modern optical techniques to investigate linear and nonlinear optical properties of materials; Materials being studied include semiconductors, metals, liquid crystals, and liquids.

96. THEORETICAL SOLID STATE PHYSICS $ 35,000 02-03
M. L. Cohen

Electronic properties of solids; work involves semiconductors and insulators with emphasis on optical and photoemission experiments while other areas of interest cover metals, superconductivity, crystal structure, amorphous materials and general theoretical investigations of solids.

97. LOW-TEMPERATURE PROPERTIES OF MATERIALS $ 85,000 03-01
N. E. Phillips

The project includes calorimetric studies of materials at low temperatures and also the development of methods for producing and measuring low temperatures. The current emphasis of the calorimetric measurements is on magnetic materials, effects of magnetic impurities on superconductivity, and liquid ^4He.

LAWRENCE BERKELEY LABORATORY
Inorganic Materials Research Division (Continued)

98. MASS AND CHARGE TRANSPORT IN ELECTROCHEMICAL SYSTEMS. PROPERTIES OF NONAQUEOUS IONIZING SYSTEMS — $ 80,000 — 03-01
C. W. Tobias

Study of the effect of hydrodynamic conditions, electrolyte and surface properties and of electrode geometry in electrosynthesis, galvanic cells, and in the shaping and finishing of metals. Elucidation of the role of mass and charge transport in electrolytic gas evolution. Electrochemical behavior of reactive metals in nonaqueous ionizing solvents: winning, refining, energy conversion.

99. HIGH PRESSURE CHEMISTRY — $ 35,000 — 03-01
G. Jura

Determination of the electrical, magnetic, and energetic changes in a solid that are associated with the change in volume of the metal. The volume changes are obtained by the use of high pressures; positron annihilation; heat capacity measurements; alpha-beta phase transition kinetics of iron; electrical resistance; and pressure as a role in the study of infrared spectra.

100. HIGH TEMPERATURE THERMODYNAMICS — $ 35,000 — 03-03
L. Brewer

Theoretical and experimental thermodynamic studies directed toward characterization of the high temperature behavior of condensed phases.

101. CRYSTALLIZATION KINETICS — $ 75,000 — 03-03
L. F. Donaghey

This program is concerned with physiochemical processing of solid state materials for device applications. The kinetics of synthesizing bulk and epitaxial films are explored for chemical vapor deposition, solution crystal growth and sputtering. Solid state chemistry and phase equilibrium studies are directed toward providing information for solid state device processing. Scale-up for industrial applications is studied through process modeling.

LAWRENCE BERKELEY LABORATORY
Inorganic Materials Research Division (Continued)

102. ELECTROCHEMISTRY, SOLID-FLUID PHASE BOUNDARIES — $145,000 — 03-03
R. H. Muller

Factors responsible for the low rate of electrochemical reactions of practical interest for the use, storage and conversion of electrical energy are investigated for the purpose of reducing their effect. Present work is centered on optical and electrochemical studies of (1) solid and liquid thin films on metals and (2) boundary layers in electrolytes.

103. CHEMICAL PROBLEMS IN NUCLEAR TECHNOLOGY — $ 80,000 — 03-03
D. Olander

Research is directed at examining in a fundamental manner some of the chemical and materials problems which are important in nuclear technology. The area of gas-solid interactions at high temperatures is studied by means of molecular beams. Analytical studies concentrate on thermal gradient redistribution of components of nuclear fuel elements and upon the separation performance of the gas centrifuge.

104. NUCLEAR MAGNETIC RESONANCE IN SOLIDS — $ 60,000 — 03-03
A. Pines

Magnetic shielding of rare nuclear isotopes in single crystals; study of phase transitions, molecular motion and anisotropic diffusion in liquid crystals and adsorbed materials; proton positional order and coherent tunneling in ferroelectrics and hydrogen bonded solids; lineshapes for random and periodically distributed nuclear spins.

105. SOLID STATE AND SURFACE REACTION STUDIES — $140,000 — 03-03
G. A. Somorjai

Studies of surface reactions and investigations of the structure of surfaces. The program may be divided into two parts: (1) Studies of the structure, chemical composition and oxidation state of surfaces and of adsorbed gases using low energy electron diffraction and Auger electron spectroscopy; and (2) Investigations of chemical surface reactions and catalysis on crystal surfaces by jointly using several techniques: molecular beam scattering, Auger electron spectroscopy, low energy electron diffraction and mass spectrometry.

MOUND LABORATORY
Monsanto Research Corporation
P. O. Box 32
Miamisburg, Ohio 45342
L. J. Wittenberg - Phone: Area Code 513 866-7444 x3571

106. LIQUID ACTINIDE METALS RESEARCH $100,000 01-03
L. J. Wittenberg, C. R. Hudgens

Characterization of the liquid state of metallic elements especially U, Np and Pu; tritium extraction studies from proposed fusion reactors; viscosity measurements of liquid U and Th; heat of transformation of Cm; x-ray diffraction studies of Ce and Pu.

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

Metals and Ceramics Division -01-
J. R. Weir, Jr. - Phone: 483-1925
C. J. McHargue - Phone: 483-1278

107. FUNDAMENTAL CERAMICS RESEARCH $210,000 01-01
G. P. Smith, J. Brynestad,
L. M. Toth, C. S. Yust, H. P. Krautwasser

Dislocation behavior, deformation, and grain boundary structure by TEM of $UO_{2\pm x}$ and pyrocarbons; thermodynamics, structure and stability of tellurides; boron carbides, uranium nitrides and europium compounds; properties of potential solid blanket materials for fusion reactors; spectroscopic studies of unusual oxidation states and defects in non-metallic crystals.

108. CRYSTAL PHYSICS $158,000 01-01
G. W. Clark, J. D. Holder, C. B. Finch

Directional solidification of metal-metal oxide binary systems; development of models for heat and mass transfer during coupled solidifications; evaluation of oxide-matrix composites for high temperature applications in gas turbines and MHD devices; hydrothermally grown quartz; single crystals doped with lanthanides and actinides.

109. THEORETICAL RESEARCH $210,000 01-01
J. S. Faulkner, G. S. Painter,
W. H. Butler, J. J. Olson, M. H. Yoo

Anisotropic elastic treatment of elastic energy of dislocations and effect of elastic self-fields on equilibrium shapes of prismatic dislocations; drift flow paths and kinetics of point defects in such fields; KKR band theory for calculating electronic states in periodic crystals having more than one atom per unit cell; multiple-scattering cluster program for electronic states of clusters of Cu, Nb, and C atoms; DVM applied to predict optical properties of silicon carbide and graphite; CPA treatment of alloys.

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

110. STRUCTURE OF METALS AND ALLOYS $105,000 01-01
R. O. Williams, R. W. Carpenter

Interrelation of thermodynamics and structure of solid solutions; ordering and clustering in Cu-Al and Ni-Mo; morphological and crystallographic relationships of "tweed" structure produced by internal oxidation of Ta-8% W-2% Hf and Nb-1% Zr.

111. FUNDAMENTAL RESEARCH IN X-RAY DIFFRACTION $210,000 01-01
H. L. Yakel, Jr., B. S. Borie,
C. J. Sparks, Jr., R. W. Hendricks

Structure of boron carbide as function of deviation from stoichiometry and effects of irradiation; structure of Eu_2O_3; diffuse x-ray and neutron scattering measurements applied to study of forbidden Bragg reflections and ω-phase formation, transformations in uranium alloys; small angle scattering studies of voids in irradiated materials.

112. DEFORMATION AND MECHANICAL PROPERTIES $ 92,000 01-02
R. A. Vandermeer, R. W. Carpenter,
J. C. Ogle

Relationships between structure and deformation and mechanical properties; "memory" effect in U-Nb-Zr alloys; stress effects on transformations from γ-stabilized uranium alloys; geometry of zone of deformation during rolling; fracture in body-centered cubic alloys; recrystallization of rolled tantalum single crystals; deformation and fracture of metal-metal oxide composites.

113. SURFACE PHENOMENA $208,000 01-03
J. V. Cathcart, R. E. Pawel,
G. F. Peterson

Mechanisms of alloy oxidation in U-, Ta-, and Nb-base alloys; oxidation generated stresses; structure of oxide films and mobility of elements in them; oxidation of composite materials; mixed gases effects.

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

114. DIFFUSION IN SOLIDS $208,000 01-03
T. S. Lundy, P. T. Carlson,
R. A. Perkins

Theoretical and experimental studies of atomic migration in solids; interdiffusion and intrinsic diffusion in V-Ti solid solutions; thermotransport of monovalent and divalent impurities in single crystals of NaCl and KCl; dislocation effects on cation diffusion in UO_2; thermal gradient and stoichiometric effects on diffusion in UN; high pressure effects on tracer diffusion in Nb, Ta, W; chemical and tracer diffusion in Fe-Cr-Ni.

115. PHYSICAL PROPERTIES RESEARCH $208,000 01-03
D. L. McElroy, R. K. Williams,
J. P. Moore, T. G. Kollie,
T. G. Godfrey

Development and application of measurement methods for obtaining accurate physical properties data (thermal conductivity, electrical resistivity, thermopower, specific heat capacity, and coefficient of thermal expansion) from 1.2 to 2600 K; analysis of data for information on energy transport mechanisms and evaluation of theories; refractory metals; nuclear ceramics; stoichiometric, mass ratio, (T/θ_D), and irradiation effects.

116. METALLURGY OF SUPERCONDUCTING MATERIALS $208,000 01-03
C. C. Koch, D. M. Kroeger, D. S. Easton

Effect of metallurgical variables on superconducting properties in Nb and Tc base alloys; ac loss mechanisms in Nb and A-15 compounds; flux pinning in Nb-Gd, Nb-Y alloys; properties of sputter deposited $Nb_{12}Al_3Ge$; development of techniques for measuring J_c; CVD W-Re; structures in A-15 compounds; low temperature specific heat measurements.

117. RADIATION EFFECTS $355,000 01-04
J. O. Stiegler, K. Farrell, E. E. Bloom,
J. M. Leitnaker, W. A. Coghlan,
N. H. Packan, W. G. Wolfer, L. K. Mansur

Void and interstitial loop formation as functions of neutron fluence, spectra, and irradiation temperature; development of quantitative relationship between neutron and heavy ion bombardment; irradiation of Al, Ni, V with self ions and "transmutation products" in Van de Graaff and ORIC; effect of composition on swelling and loss of ductility in Al and Fe-Cr-Ni "model" systems; in situ studies by HVEM; theoretical treatment of nucleation and growth of defect clusters and kinetic effects of accelerated irradiation; simulation of radiation creep; effects of high gas contents on structure and properties.

OAK RIDGE NATIONAL LABORATORY
Solid State Division -02-
M. K. Wilkinson - Phone: 483-6713
F. W. Young, Jr. - Phone: 483-1704

118. NEUTRON SPECTROMETRY $385,000 02-01
H. G. Smith, W. Kamitakahara, R. M. Nicklow, H. A. Mook, N. Wakabayashi

Inelastic neutron scattering from magnetic and nonmagnetic systems; critical scattering near chemical and magnetic phase transitions; phonon dispersion curves of high critical temperature superconductors; temperature dependence of spin waves in iron and nickel; stoner modes in nickel; inelastic coherent neutron scattering from metal hydrides; high momentum transfer studies in ^4He; quasi-elastic studies of metal hydrides; lattice dynamics of covalent and molecular crystals; phonon density of states measurements of amorphous and polycrystalline materials; phonon measurements in disordered alloys; magnetic interactions in rare earth-Y alloys.

119. NEUTRON DIFFRACTION $470,000 02-01
W. C. Koehler, J. W. Cable, H. R. Child, R. M. Moon

Elastic and inelastic scattering of polarized and unpolarized neutrons by magnetic systems; form factors and magnetic moment distributions in weakly paramagnetic systems, Pd, Sc, Y; neutron magnetic disorder scattering in Fe containing magnetic and nonmagnetic impurities; magnetic form factors of EuO, $TmCo_2$, CoS_2; short range order and magnetic susceptibility of Gd_2O_3, crystal field levels, spin densities, exciton spectra and magnetic structure for $TmNi_2$, critical scattering from ^{160}Gd, field dependence of spin waves in Dy.

120. SMALL ANGLE NEUTRON SCATTERING $ 25,000 02-01
H. A. Mook

Development of small angle neutron scattering instrumentation and techniques; feasibility experiments for measurements of void distributions in irradiated aluminum; extension to systematic study of void formation and growth in Al, stainless steels, and other reactor materials.

OAK RIDGE NATIONAL LABORATORY
Solid State Division -02-

121. RESEARCH AND DEVELOPMENT ON PURE MATERIALS — $500,000 — 02-02
J. W. Cleland, G. C. Battle, W. E. Brundage, T. F. Connolly, R. E. Reed, C. C. Robinson, U. Roy, R. D. Westbrook

Purification, crystal growth, characterization, and analysis of research quality materials; Research Materials Information Center; arc-fusion growth of MgO, CaO, BaO, and SrO; Czochralski growth of Ge(Li), Ge(HP) radiation detector crystals; electron beam float zone growth of refractory single crystal V, Nb, Zr, Ir, and Re and alloys; isotopic ^{58}Ni single crystals; grain growth of single crystal rare earths and rare earth alloys; modified Bridgman growth of isotopic ^{153}EuO; Bridgman growth of large single crystal ferrites; Bridgman growth of large single crystal fluoride perovskites.

122. INSULATING MATERIALS FOR MAGNETOHYDRODYNAMICS GENERATORS — $ 0 — 02-02
R. A. Weeks

Electrical conductivity of refractory oxides (SiO_2, MgO, $(1-x)SiO_2:xMgO$) at high temperatures, in large electric fields and in intense radiation fields. Effects of oxygen partial pressure, point defects, aggregated defects on electrical conductivity, temperature dependence of damage; to start in FY 1975.

123. HIGH TEMPERATURE MATERIALS — $ 0 — 02-02
F. W. Young, R. E. Reed, J. B. Bates, L. H. Jenkins, Y. Chen

Physical properties at high temperatures of refractory metals and their alloys and of insulators. Macroscopic and microscopic mechanical properties and surface properties of metals. Single crystals and glasses of SiO_2, MgO, and ThO_2; effects of intrinsic and extrinsic ionic disorder on high temperature electrical conductivity and dielectric properties; to start in FY 1975.

OAK RIDGE NATIONAL LABORATORY
Solid State Division -02-

124. SURFACE STUDIES ON METALS $240,000 02-02
L. H. Jenkins, J. R. Noonan,
D. M. Zehner, F. W. Young

Low energy ion damage to metal surfaces; sputtering of metals by 14 MV neutrons; LEED and Auger electron spectroscopy of Au and Ag films used in hyperchanneling studies; quasi-atomic structure in Auger spectra from "d" electron band solids; thin oxide overlayers on metal substrates; secondary electron spectra; x-ray diffuse scattering from defect clusters in Cu single crystals; Rutherford ion backscattering from metal surfaces.

125. DEFECT STRUCTURES IN NONMETALS $305,000 02-02
E. Sonder, Y. Chen, F. Modine,
J. C. Pigg, L. C. Templeton

Optical absorption and emission and ESR studies of insulators related to defect structure; optical investigations of V^- center production by electron irradiation; F center identification in fluorides with perovskite structure by optical absorption, EPR, and MCD techniques; influence of phase changes on defect properties and production rates; energy stored in NaCl by ionizing radiation; "charge-transfer" transitions in doped insulating materials.

126. SPIN RESONANCE $135,000 02-02
M. M. Abraham, Y. Chen, R. A. Weeks

EPR to study impurity centers and radiation induced defects in diamagnetic insulating crystals; defect structure and magnitude of local crystal fields; doping of alkaline earth oxides with alkali metals; magnetic resonance spectra of actinide isotopes in various fluorite-type hosts--ThO_2, $SrCl_2$, CaF_2, etc.; nature of S-state ions; EPR and optical studies of V_{OH}, V^-_{OH}, and V^- centers and their deuterium analogues in cubic oxides.

127. SUPERCONDUCTIVITY $ 70,000 02-02
S. T. Sekula, H. R. Kerschner, W. C. Koehler

Bulk magnetization measurements and low frequency magnetic permeability measurements of heavily irradiated superconducting metals V, Nb, and alloys Nb-Ti and Nb-Zr. Low frequency magnetic permeability measurements on pure annealed single crystals for studies of fluxoid motion; fluxoid pinning and fluxoid motion in A-15 type compounds by electromagnetic methods and neutron small angle scattering; neutron inelastic scattering studies of high T_c alloys.

OAK RIDGE NATIONAL LABORATORY
Solid State Division -02-

128. THEORY AND COMPUTATIONS $540,000 02-03
R. F. Wood, M. T. Robinson, H. L. Davis, J. H. Barrett, J. H. Cooke, D. K. Holmes, T. Kaplan, M. E. Mostoller, O. S. Oen

Radiation damage; lattice dynamics, magnetism; electronic structure of solids; computer simulation of radiation damage, standardization of displacement dose estimation procedures; cross sections for displacing atoms in solids by fast electrons, ion bombardment damage simulation; reflection of light atoms from surfaces; Monte Carlo channeling calculations; determination of nuclear lifetimes from blocking patterns, hyperchanneling; ferromagnetism in transition metals; spin wave and Stoner band calculations in Ni and Fe; interpolation of electronic energy bands; Brillouin zone integration; Heisenberg spin systems; lattice vibrations in substitutionally disordered alloys; the coherent potential approximation; vibrational properties around substitutional impurities in insulators; electron screening and phonon spectra; lattice dynamics of superconductors; crystal-field splittings in rare earth compounds; band structure calculations for rare-earth and actinide compounds; electronic structure and optical properties of defects in insulators.

129. RADIATION EFFECTS IN METALS $448,000 02-04
R. R. Coltman, C. E. Klabunde, J. M. Williams, J. K. Redman

Thermal and fission neutron damage in Mo, Nb, V, Ta; elastic constant changes in thermal neutron irradiated Cu; electron irradiation of Cu, V; density changes and resistivity measurements on fast neutron irradiated metals; magnetoresistance of thermal neutron irradiated V, Cu, Pt.

130. ION BOMBARDMENT $170,000 02-04
B. R. Appleton, O. E. Schow, J. W. Miller

Near-surface properties of metals by ion scattering and channeling investigations on 2.5 MV positive ion accelerator; hyperchanneling studies in Au and Ag single crystals of 0.3 to 2.0 MeV H and He, and 18-40 MeV O and I ions; stopping powers, charge exchange, and radiative electron capture as a function of charge state for 18-40 MeV O ions in Au and Ag single crystal channels; determination of charge states of heavy ions within solids by characteristic x-ray yield measurements of O and Ar ions in gasses and solids; radiation damage studies of gasses implanted in metals; energy and yield measurements of electrons ejected by heavy ions transmitted through thin foils and/or single crystals.

OAK RIDGE NATIONAL LABORATORY
Solid State Division -02-

131. X-RAY DIFFRACTION AND ELECTRON MICROSCOPY — $230,000 — 02-04
T. S. Noggle, S. M. Ohr, B. C. Larson, J. B. Roberto, J. Narayan, F. A. Sherrill

Radiation damage in nearly perfect Cu crystals; anomalous x-ray transmission; x-ray diffuse scattering, high precision measurement of lattice parameter change, transmission electron microscopy, ion damage, dislocation channeling, single crystal films, anisotropic elasticity theory of dislocation loops, theory of interaction of electrons and x-rays with defects in solids.

132. NORMALIZATION OF ION AND NEUTRON DAMAGE — $ 0 — 02-04
T. S. Noggle, O. S. Oen

Normalization of damage production rates using fission neutron and 5 MeV Al ion irradiation of thin films of Al; damage theory computations; to start in FY 1975.

Chemistry Division -03-
E. H. Taylor - Phone: 483-6444

133. NEUTRON AND X-RAY DIFFRACTION — $465,000 — 03-01
H. A. Levy, G. M. Brown, W. R. Busing, C. K. Johnson, A. H. Narten, W. E. Thiessen

Neutron and x-ray diffraction studies of crystal structure, hydrogen bonding, biochemical compounds. Techniques of crystal structure analysis. Theoretical analysis of energetics of binding in crystals. Neutron and x-ray diffraction studies of structure in simple liquids, solutions, and amorphous solids. Theoretical analysis of structure in liquids. Computer simulation of liquid systems.

134. THERMODYNAMICS AND TRANSPORT IN MOLTEN SALTS AND HYDROUS MELTS — $121,000 — 03-03
J. Braunstein, A. L. Bacarella

Experimental and theoretical studies of molten salts and highly concentrated aqueous solutions (hydrous melts). Measurements include vapor pressure, electromotive force, diffusion and voltammetry.

OAK RIDGE NATIONAL LABORATORY
Chemistry Division -03-

135. SURFACE CHEMISTRY $102,000 03-03
H. F. Holmes, P. A. Agron,
E. L. Fuller

Surface characterization of important refractory oxides (e.g. ThO_2, ZrO_2). Calorimetric measurement of heats of adsorption of H_2O from 25 to 200°C. Adsorption measurements with vacuum microbalance system between 77°K and 1000°C. Infrared spectra of adsorbed species up to 800°C.

136. ELECTROCHEMICAL KINETICS AND CORROSION $198,000 03-03
F. A. Posey, H. R. Bronstein,
E. J. Kelly, R. E. Meyer

Mechanisms of corrosion reactions, particularly of titanium, including active and passive states and corrosion in restrictive geometries (pitting and crevice corrosion). Properties of electrode systems designed with attention to both electrochemical and hydrodynamic properties (porous, capillary and channel electrodes, suspension electrodes, etc.). Applications of such systems to analysis or electrolytic treatment of flowing streams.

Chemical Technology Division -03-
D. E. Ferguson - Phone: 483-6051

137. BASIC MATERIALS CHEMISTRY $185,000 03-02
RELATED TO FUSION REACTOR SYSTEMS
L. M. Ferris, F. J. Smith,
J. T. Bell, S. Cantor

Obtain basic data on behavior of tritium in CTR blanket-coolants; measure equilibria in lithium-hydrogen isotope systems; determine permeation behavior of hydrogen isotopes through clean and oxide-filmed metals and alloys; assess MHD and potential corrosive effects with molten-salt blanket-coolants.

138. PREPARATION AND PROPERTIES OF $110,000 03-02
ACTINIDE CARBIDES AND NITRIDES
T. B. Lindemer, R. G. Haire,
I. L. Thomas, J. C. Griess

Properties, reactions, and thermodynamics of the ceramic oxides, carbides, and nitrides of the actinides and lanthanides; their interactions with the structural metals Fe, Cr, Ni; hydrolysis and passivation of UC; study of colloidal hydrous oxides in sol-gel production of ceramics; theoretical modeling of hydrosols.

OAK RIDGE NATIONAL LABORATORY
Chemical Technology Division -03-

139. CHEMICAL ENGINEERING RESEARCH-MATERIALS SCIENCE — $126,000 — 03-02
C. D. Scott, W. W. Pitt, P. A. Haas

Development of new and improved methods of formation of well-defined small sorbent particles by the sol-gel technique; study of the adiabatic oxidation of graphite as a potential processing technique.

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

140. TRANSURANIUM CERAMICS RESEARCH $ 80,000 01-01
T. D. Chikalla, R. P. Turcotte

Solid state properties of transuranium ceramics with emphasis on thermodynamic and structural behavior especially as affected by self-radiation damage; phase behavior and thermodynamics in the (Bk, Cf)O_x and NpO_x systems; radiation damage in $^{238}PuO_2$; high temperature x-ray diffraction; electrical conductivity and electron microscopy studies of self-radiation damage and annealing.

141. TRANSURANIUM PHYSICAL METALLURGY RESEARCH $305,000 01-03
R. D. Nelson, S. D. Dahlgren,
M. D. Merz, R. P. Allen

Metallurgy of Pu and Np; studies of sputter deposited superconductors; phase transformations in bulk and sputter deposited Pu; deformation mechanisms of Pu allotropes; creep properties of Pu; deformation and phase transformations of Np; self-radiation damage and annealing characteristics of alpha-Pu; sputter deposition of A-15 superconducting compounds, Nb-Al-Ge, Nb-Al, Nb-Ge, Nb-Si, Nb-Ga; relationship between grain size, heat treatment and critical current for sputter deposited superconductors.

142. RADIATION EFFECTS ON METALS $260,000 01-04
J. L. Brimhall, H. E. Kissinger,
E. Simonen

Production, migration, annihilation and coalescence of irradiation produced defects; variables under study include irradiation conditions and material parameters; materials of interest include Mo, Nb, Ni and Re; heavy ion bombardment of Mo; simultaneous He and heavy ion bombardment; neutron irradiations at ORR and LLL - 14 MeV source; neutron irradiation studies of Cu-Ni; study of grain boundary effects; irradiation with Pu-238 alpha source.

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.

ARIZONA STATE UNIVERSITY

201. SOLID STATE CHEMISTRY OF RARE EARTH OXIDES — $ 55,000 — 03-01
L. Eyring - Dept. of Chemistry

Study of phase stability, structure, defects, composition ranges, thermodynamic properties of lanthanide oxide systems using x-ray diffraction, high resolution electron microscopy, selected area electron diffraction, and thermogravimetry, nonstoichiometry, ordered intermediate phases, order-disorder transformations, chemical hysteresis and pseudophase formations in lanthanide oxide model systems.

202. STUDY OF FERRITE FORMATION IN NEUTRON IRRADIATED AUSTENITIC STAINLESS STEELS — $ 32,858 — 01-04
J. T. Stanley - Engineering Mechanics, Materials & Measurements Dept.

Determination of the amount of ferrite formed in neutron irradiated 316 stainless steel, magnetization measurements, post irradiation annealing studies, electron microscopy.

BROWN UNIVERSITY

203. A COMBINED MACROSCOPIC AND MICROSCOPIC APPROACH TO THE FRACTURE OF METALS — $ 80,000 — 01-02
J. Gurland and J. R. Rice - Division of Engineering

Experimental and analytical study of brittle and ductile fracture in plain carbon steels, including: the influence of microstructure on the conditions of brittle fracture at a macroscopic crack tip; the effect of stress triaxiality and plastic strain on the initiation, growth, and coalescence of voids during ductile rupture; effect of grain size and second phase particles on yield strength and strain hardening; interrelation of microstructure or micro-scale deformation mechanisms with macroscopic metal behavior.

204. STUDIES OF ALLOY STRUCTURES AND PROPERTIES — $174,791 — 01-01
P. Duwez - Division of Engineering

Structure and properties of metastable alloys obtained by rapid cooling from the melt, properties of new superconducting alloys, properties of metastable amorphous alloys as a function of composition, electrical resistivity, magnetoresistivity, thermoelectric power, magnetic susceptibility, copper-base superconducting alloys containing Nb_3Sn, V_3Ga or V_3Si, amorphous superconducting La-Au alloys.

CALIFORNIA, UNIVERSITY OF

205. PARTICLE SIZE DISTRIBUTION EFFECTS IN PRECIPITATION HARDENING — $ 65,000 — 01-02
A. J. Ardell - Materials Dept., Los Angeles

Critical resolved shear stress in single crystals as a function of precipitate size distribution, effects of bimodal precipitate distributions, theoretical research on the effect of voids on the range and energy deposition of charged particles, experimental studies of void formation in proton irradiated and electron irradiated Ni-base alloys.

206. FOURIER SPACE COMPUTER SIMULATION OF CRYSTALLINE IMPERFECTIONS — $ 32,000 — 01-01
D. de Fontaine - Materials Dept., Los Angeles

Development of computer programs for elastic energies and atomic displacements of defects in solids, effect on diffusion and phase transformations, one-dimensional model for the kinetics of defects or vacancies, stability of void superlattices in irradiated materials.

207. ELECTRIC AND MAGNETIC PROPERTIES OF TRANSITION METALS AND THEIR COMPOUNDS — $ 71,490 — 02-02
A. W. Lawson and G. E. Everett - Dept. of Physics, Riverside

Study of electric and magnetic properties of transition metals and their compounds (such as EuSe, EuTe, GdN, DySb, and EuO); magneto-elastic energy, antiferro-magnetism, standing wave resonance techniques, non-stoichiometric effects; single crystal growth.

208. NEW MATERIALS BY LOW TEMPERATURE CONDENSATION — $ 80,000 — 01-03
Huey-Lin Luo - Dept. of Applied Physics and Information Science, San Diego

Sputtering technique applied to preparation of materials - superconductors (Nb_3Al, Nb_3Ge, Nb_3Ga) and amorphous phases, heat capacity measurements of amorphous materials.

CALIFORNIA, UNIVERSITY OF (Continued)

209. RESEARCH ON THE PROPERTIES OF MATERIALS AT VERY LOW TEMPERATURES — $290,050 — 02-02
J. C. Wheatley - Dept. of Physics, San Diego

Experimental properties of normal and superfluid liquid He-3 at temperatures in the low milli-Kelvin region; correlated spins in superfluid He-3; anisotropy in superfluid He-3; effects of flow, boundaries, and magnetic field on orienting the spin and orbital motions of superfluid He-3; phase diagram; density; static magnetism; absolute temperature scale; sound propagation; viscosity.

CARNEGIE-MELLON UNIVERSITY

210. GENERALIZATION OF INTERNAL CENTRIFUGAL ZONE GROWTH OF METAL-CERAMIC COMPOSITES — $ 29,385 — 01-01
R. F. Sekerka - Dept. of Metallurgy and Materials Science

Experimental and analytical investigation of the internal centrifugal zone growth casting process for ceramics, cermets, and semiconductors, of various geometries, materials properties, and heating methods.

CASE WESTERN RESERVE UNIVERSITY

211. DISLOCATION-SOLUTE ATOM INTERACTIONS IN ALLOYS — $ 43,000 — 01-02
R. Gibala - Dept. of Metallurgy and Materials Science

Nature of solute obstacles to dislocation motion, interstitial and substitutional solute hardening and softening and the effect of solute partitioning on strengthening of Nb, effects of solute gradients on strengthening, hydrogen embrittlement in refractory metal alloys.

212. SOLID STATE PHYSICS — $ 82,969 — 02-02
R. W. Hoffman - Dept. of Physics

Mössbauer emission spectroscopy of various crystal faces of Co, Fe and Ni, internal stress in Ni films; ultracentrifuge apparatus for adhesion measurements, mass effects in the dielectric and elastic properties of LiF, pressure dependence of the dielectric constant for MgF_2, sapphire and alpha quartz, calculations of spin wave spectrum of an amorphous ferromagnet and transport properties of normal metals.

CASE WESTERN RESERVE UNIVERSITY (Continued)

213. EXPERIMENTS IN HIGH VOLTAGE ELECTRON MICROSCOPY — $ 55,432 — 01-04
T. E. Mitchell - Div. of Metallurgy and Materials Science

High voltage (650 kV) electron microscopy to study in-situ radiation damage and selected area diffraction of precipitates; role of dislocations as biased sinks for interstitials in the formation of voids in Cu, Ni and stainless steel; planar defects and voids in V; radiation-enhanced precipitation in Al alloys and stainless steels; radiation effects in quartz and sapphire.

CHICAGO, UNIVERSITY OF

214. THE STUDY OF PHONONS AND ELECTRONIC PROCESSES IN AMORPHOUS AND CRYSTALLINE SOLIDS — $ 42,000 — 02-02
S. A. Solin - Dept. of Physics

Spontaneous and resonance Raman spectroscopy at 0.5, 1.0 and 2.1 micron; infrared spectroscopy; optical mixing; high pressure techniques employed to study vibrational and electronic excitations in amorphous and crystalline solids; electron-phonon interactions in Ge, photostructural changes in As_2S_3 amorphous films.

CINCINNATI, UNIVERSITY OF

215. RADIATION EFFECTS TO BCC REFRACTORY METALS AND ALLOYS — $ 45,000 — 01-04
J. Moteff - Dept. of Materials Science & Metallurgical Engineering

Defect structures in neutron irradiated Mo, Mo-0.5Ti, Nb and Nb-1Zr, effect of annealing temperature, transmission electron microscopy, charged particle irradiations of Mo, Mo-0.5Ti and TZM alloys.

CLARKSON COLLEGE OF TECHNOLOGY

216. NUCLEATION OF VOIDS — $ 18,344 — 01-04
J. L. Katz - Dept. of Chemical Engineering

Theory of void nucleation, precipitation of interstitial loops, effect on nucleation of immobile gas and stress, applications to the system Ni-He.

CONNECTICUT, UNIVERSITY OF (Continued)

221. CLUSTER CARBURIZING — $ 37,015 — 01-01
J. E. Morral - Dept. of Metallurgy and Inst. of Materials Science

Nucleation and growth of carbide precipitates, and the precipitate morphology, in the Ta-Hf-C alloy system, using hardness and electron microscopy and diffraction methods.

CORNELL UNIVERSITY

222. DEFECTS IN METAL CRYSTALS — $210,000 — 01-04
R. W. Balluffi and D. N. Seidman - Dept. of Materials Science and Engineering

Study of point, line and planar defects in metals; FIM investigations of quenched or irradiated metals; FIM studies of interstitial atoms in FCC and BCC metals; FIM and electrical resistivity studies of vacancy defects in FCC and BCC metals; FIM studies of solute atoms in Pt alloys; application of Atom Probe FIM to point defect studies; measurement of focused replacement sequence ranges in Au; studies of grain boundary structure and diffusional short-circuiting.

223. EFFECT OF ENVIRONMENT ON FRACTURE BEHAVIOR — $ 53,800 — 01-02
H. H. Johnson - Dept. of Materials Science and Engineering

Study of hydrogen permeation following electrochemical charging; correlation between gas phase and electrochemical charging results; hydrogen trapping and permeation through annealed and deformed zone refined Fe; relation between hydrogen trapping and microstructures of steel.

224. A STUDY OF THE INTERACTION BETWEEN MAGNETIC FLUXOIDS AND CRYSTAL DEFECTS IN TYPE II SUPERCONDUCTORS — $ 39,673 — 01-03
E. J. Kramer - Dept. of Materials Science and Engineering

Flux line lattice pinning by point defect clusters introduced by fast neutron irradiation of Nb and Nb-Mo alloys; pinning effect of dislocation cell walls in cold rolled Nb, microstructural pinning rules predicted by flux pinning models.

COLORADO SCHOOL OF MINES

217. LIQUID LITHIUM CORROSION AND CORROSION-FATIGUE RESEARCH — $ 40,000 — 01-01
D. L. Olson and W. L. Bradley - Dept. of Metallurgical Engineering

Liquid lithium corrosion of Fe, effects of stress, grain boundary grooving, weight loss and penetration determinations, stress rupture experiments, effect of Cr additions, effects of liquid lithium impurities.

COLORADO, UNIVERSITY OF

218. CRITICAL SCATTERING OF LASER LIGHT BY BULK FLUIDS AND THIN FLUID FILMS — $ 44,000 — 02-02
R. Mockler and W. O'Sullivan - Dept. of Physics and Astrophysics

Anomalous refractive index near the critical point of a binary mixture; studies of light scattered from Brownian particles in a critical fluid; films to be studied in thicknesses less than the correlation lengths; shift in critical temperature with spacing.

COLUMBIA UNIVERSITY

219. HIGH TEMPERATURE TRANSPORT PROPERTIES AND PROCESSES OF GASES AND ALKALI METALS — $ 31,000 — 03-02
C. F. Bonilla - Dept. of Chemical Engineering

Study of physical properties such as thermal conductivity and critical points of metal vapors (Na, Li and Hg) at high temperatures and pressures, using pressure tube techniques.

CONNECTICUT, UNIVERSITY OF

220. ELECTRON-DISLOCATION INTERACTIONS AT LOW TEMPERATURES — $ 34,187 — 01-02
J. M. Galligan - Dept. of Metallurgy

Plastic deformation of Pb, Cu, and Nb alloys above and below their superconducting transition temperature, dislocation interactions with electrons and other defects in crystals at various temperatures and magnetic fields, growth and purification of single crystals.

CORNELL UNIVERSITY (Continued)

225. THEORY OF STRUCTURE AND DYNAMICS IN CONDENSED MATTER — $ 60,000 — 02-03
J. A. Krumhansl - Dept. of Physics, Laboratory of Atomic and Solid State Physics

Theory of quantum and classical lattice excitations in condensed matter and their contributions to electrical, thermal and optical properties; highly anharmonic solids; excitations in disordered systems; transport involving phonons; computer studies of liquids; soft modes; thermal properties of amorphous and disordered structure; dynamics of structural phase transitions.

226. GRAIN BOUNDARY SLIDING AND STRUCTURE — $ 40,000 — 01-02
Che-Yu Li - Dept. of Materials Science and Engineering

Role of grain boundary sliding in plastic deformation and its dependence on grain boundary structure; stress relaxation experiments on Pb and Al alloys; stress dependence of grain boundary sliding; grain boundary sliding rate versus grain matrix deformation; effects of second phase particles dispersed in the grain boundary.

227. EXPERIMENTAL PHONON PHYSICS — $136,000 — 02-02
R. O. Pohl and A. J. Sievers - Dept. of Physics, Laboratory of Atomic and Solid State Physics

Lattice vibrations in noncrystalline and polycrystalline solids; sintered powders; bulk elastic constants; low temperature specific heat; thermal conductivity; far infrared absorption; properties of insulators by excited state spectroscopy of molecular impurities in crystals; far infrared properties of donors and acceptors in Bi.

228. ELASTIC AND PLASTIC DEFORMATION OF SOLIDS — $120,000 — 01-02
A. L. Ruoff - Dept. of Materials Science and Engineering

Second pressure derivative of bulk modulus and other elastic constants using combined length and ultrasonic transit time; LiF, NaCl, Na; pressure dependence of the Gruneisen parameter; CsCl crystals grown directly from the melt under pressure; pressure dependence of the yield stress of Pb and K; ultrafine sintered carbides by isostatic compaction; attempt to prepare metallic ammonium.

CORNELL UNIVERSITY (Continued)

229. SOLID STATE PHYSICS: MAGNETIC PHENOMENA — $115,800 — 02-02
R. H. Silsbee and R. Bowers - Dept. of Physics

Microwave resonance in KCl:Li and metals with rare earths or transition metal impurities; low temperature phonon dynamics; conduction electron-impurity interactions; transport properties using radio frequency size effect resonance methods to study electronic scattering processes in metals; electromagnetic generation of acoustic waves in Ni and Fe.

DARTMOUTH COLLEGE

230. THEORY OF ELECTRON-PHONON SCATTERING EFFECTS IN METALS — $ 16,671 — 02-03
W. E. Lawrence - Dept. of Physics and Astronomy

Effects of anisotropic electron-phonon scattering on the anisotropies of the quasiparticle and transport relaxation times in metals; anisotropies of the electronic mass enhancement and the superconducting energy gap; quasiparticle lifetime, mass enhancement and resistivity calculated for Al; umklapp electron-phonon processes.

231. EXPERIMENTAL DETERMINATION OF THE TEMPERATURE DEPENDENCE OF METALLIC WORK FUNCTIONS AT LOW TEMPERATURES — $ 25,240 — 02-02
P. B. Pipes - Dept. of Physics and Astronomy

Temperature dependence of metallic work functions as a function of temperature, magnetic field and surface condition; Nb, Cu, Al, Zn and Pb; superconducting microbridges under the influence of thermal gradients; contributions of chemical potential and surface dipole layer to the electronic work function.

FLORIDA, UNIVERSITY OF

232. QUANTITATIVE ANALYSIS OF SOLUTE SEGREGATION IN ALLOYS BY TRANSMISSION ELECTRON MICROSCOPY — $ 39,000 — 01-01
J. J. Hren and C. S. Hartley - Dept. of Metallurgical and Materials Engineering

Computer matching of 2-beam dynamical electron microscope images of dislocations and stacking faults; quantitative characterization of small precipitates, dislocation loops and voids; electron microscopy and computer matching of experimental images.

233. DEFORMATION PROCESSES IN REFRACTORY METALS — $ 36,927 — 01-02
R. E. Reed-Hill - Dept. of Materials Science and Engineering

Effects of dynamic strain aging and deformation twinning on Nb; some work will continue on hexagonal metals such as Ti and Zr; stress-strain curve analyses; temperature range from 77 to 1250 K; strain rates between 10^{-5} and 10^{-2}/sec.; dislocation structure associated with rate dependent work hardening peaks.

GEORGETOWN UNIVERSITY

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

Low temperature properties of pure single crystals; superconductive tunneling; heat capacity; DC magnetization; a.c. susceptibility; boundary scattering; superconducting critical field and resistivity tensor in the metals Ga, In, Zn, Sn, Pb and Al; superconductivity in fast-frozen Ga-In.

HAWAII, UNIVERSITY OF

235. PRESSURE DERIVATIVES OF ELASTIC MODULI IN B.C.C. TRANSITION METALS AND THEIR SOLID SOLUTIONS — $ 22,675 — 02-02
M. H. Manghnani - Dept. of Geology and Geophysics

Pressure dependence of elastic moduli of single crystal pure and alloyed V, Nb and Ta at room temperature up to 7 kb; pulse superposition and pulse-echo-overlap techniques to measure wave propagation velocities; Ti and Zr base alloys containing transition metal solutes.

HAWAII, UNIVERSITY OF (Continued)

236. PHOTOELECTRIC EMISSION FROM THIN FILMS IN THE VACUUM ULTRAVIOLET REGION — $ 27,836 — 02-02
W. Pong - Dept. of Physics and Astronomy

Determination of density of states of energy of alkali and rare earth fluoride single crystals and thin solid films using photoemission measurements; photoelectric and optical properties of organic films and thin films of metals, metal oxides and nitrides; ac method to measure the energy distributions of photoelectrons excited by dispersed radiation of photon energies 12 to 23 eV.

HOWARD UNIVERSITY

237. RADIATION DAMAGE IN OPTICALLY TRANSPARENT MATERIALS (ZIRCONS) — $ 20,000 — 02-04
A. N. Thorpe - Dept. of Physics

Physical properties of natural and synthetic doped zircon, irradiated with alpha particles, neutrons, and gamma rays, visible and infrared absorption, low temperature magnetic properties, and thermoluminescence, comparison between damage produced by neutron induced fission and that produced by alpha particle recoil from natural U and Th decay.

ILLINOIS INSTITUTE OF TECHNOLOGY

238. THE STRENGTHENING AND TOUGHENING OF BRITTLE MATERIALS — $ 30,000 — 01-02
L. J. Broutman - Dept. of Metallurgical and Materials Engineering

Measurement of strength and fracture toughness of brittle fiber-reinforced composites of glass fibers in a polymeric matrix; effects of temperature, matrix residual stress, interfacial strength, and fiber coating.

239. THERMAL MEASUREMENTS ON SOLIDS AT LOW TEMPERATURES — $105,000 — 02-02
H. Weinstock - Dept. of Physics

Study of irradiation induced defects in MgO, graphite, Al_2O_3, CaO, V, Ta, and epoxies, using thermal conductivity measurements; critical current density measurements of irradiated Nb and Nb_3Sn; thermal conductivity of thin film Pb, Pb-Tl alloys, and Kondo alloys of Cu containing less than 0.1% Fe or Cr.

JOHNS HOPKINS UNIVERSITY

240. ACOUSTIC EMISSION AND THE PORTEVIN-LE CHATELIER EFFECT — $ 32,000 — 01-02
W. F. Hartman - Dept. of Mechanics and Materials Science

Variations in acoustic emission as a function of grain size, stress rate and temperature; polycrystalline and single crystals of metals and alloys; acoustic-emission simulation and calibration techniques.

KANSAS, UNIVERSITY OF

241. HIGH TEMPERATURE CHEMISTRY — $ 64,000 — 03-03
P. W. Gilles - Dept. of Chemistry

Vaporization studies on refractory binary and ternary systems of oxides and sulfides; Knudsen effusion, torsion effusion and mass spectrometric techniques; effect of the degree of saturation on the rate of vaporization of single crystals.

LEHIGH UNIVERSITY

242. PRESSURE SINTERING AND CREEP DEFORMATION - A JOINT MODELING APPROACH — $ 37,000 — 01-01
M. Notis - Dept. of Metallurgy and Materials Sciences

Compare the densification during the later stages of pressure sintering and the creep deformation behavior for two oxide materials, CoO and $MgAl_2O_4$; effect of stress level, temperature, grain size, porosity and stoichiometry.

MARQUETTE UNIVERSITY

243. DEFECT STRUCTURES IN NONSTOICHIOMETRIC OXIDES — $ 37,310 — 01-01
R. N. Blumenthal - Dept. of Mechanical Engineering

Defect structure and transport properties of defects in pure and doped nonstoichiometric oxides; thermodynamic and electrical behavior of CeO_2; electrical conductivity, Hall mobility, ionic transference and thermogravimetric weight measurements as a function of oxygen partial pressure, oxygen nonstoichiometry, dopant concentration and temperature.

MARYLAND, UNIVERSITY OF

244. AN INVESTIGATION OF IRRADIATION STRENGTHENING OF BCC METALS AND SOLID SOLUTIONS — $ 46,000 — 01-02
R. J. Arsenault - Dept. of Chemical Engineering

Effect of impurity interstitials on the change in the effective stress due to neutron irradiation; interaction between hydrogen and neutron-produced damage; effect of He on dislocation dynamics; effect of alpha particle irradiation on the deformation characteristics of BCC metals.

245. ALLOY STRENGTHENING DUE TO ATOMIC ORDER — $ 28,948 — 01-02
M. J. Marcinkowski - Dept. of Mechanical Engineering

Computer modeling of the interaction between non-intersecting, non-coaxial dislocation loops; stress-strain behavior of ordered alloys; dislocation theory; atomic order; transmission electron microscopy.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

246. LOW TEMPERATURE AND NEUTRON PHYSICS STUDIES — $104,986 — 02-01
C. G. Shull - Dept. of Physics

Polarized neutron scattering of specimens at high magnetic field to study the diamagnetic density of nuclei of pure Bi and to examine the polarization of Li^7 nuclei in LiF, measurement of the neutron Pendellösung fringe structure in perfect copper crystals and aspects of crystallographic phase transformations associated with the superconducting transition in compounds such as ZrV_2 and $NbSe_2$.

247. THERMAL NEUTRON SCATTERING STUDIES OF MOLECULAR DYNAMICS AND CRITICAL PHENOMENA IN FLUIDS AND SOLIDS — $ 85,000 — 02-01
S. H. Chen and S. Yip - Dept. of Nuclear Engineering

Use of triple axis neutron spectrometer at MIT research reactor to study molecular dynamics in gases and liquids; light scattering experiments; neutron scattering on hydrogen gas at high pressures and temperatures; neutron scattering on liquid Ga; theory of neutron and light scattering.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

248. BASIC RESEARCH IN CRYSTALLINE AND NONCRYSTALLINE CERAMIC SYSTEMS — $300,000 — 01-01
W. D. Kingery and R. L. Coble - Dept. of Metallurgy and Materials Science

Defect structures; mobilities and atomic transport at grain boundaries; effects of thermal gradients on non-stoichiometric oxide solid solutions $(U, Ce)O_2$; particle size distribution effects in microstructural development during sintering; chemical vapor deposition methods for crystal preparation; grain boundary structure and properties; proton activated sintering; characterization of fluorite structures.

MICHIGAN STATE UNIVERSITY

249. AN INVESTIGATION OF SOME LANTHANIDE CARBON, NITROGEN, CHALCOGEN, AND HALOGEN SYSTEMS AT ELEVATED TEMPERATURES — $ 25,000 — 03-03
H. A. Eick - Dept. of Chemistry

Determination of thermochemical data for lanthanide binary and ternary phases to be obtained using vapor pressure (Knudsen effusion - target collection) technique; correlation of this data with structural information obtained from x-ray diffraction measurements and composition obtained from mass spectrometry and x-ray fluorescence methods; YbS, Sm_2C_3, YbF_2, TmF_3, YbF_3, SmF_2, Eu_4OBr_6, YbI_2, YbSe, $YbBr_2$.

250. PROPERTIES OF RARE GAS SOLIDS — $ 43,524 — 02-02
G. L. Pollack - Dept. of Physics

Thermal conductivity of molecular solids such as Ar, He, Kr and Xe, Kapitza resistance evaluation using data on wave attenuation at metal surfaces and density of liquid He at the interface with a metal; diffusion of rare gases through films of biological materials.

MICHIGAN TECHNOLOGICAL UNIVERSITY

251. A STUDY OF GRAIN BOUNDARY SEGREGATION USING THE AUGER ELECTRON EMISSION TECHNIQUE — $ 44,000 — 01-02
D. F. Stein - Dept. of Metallurgical Engineering

Investigation of causes, effects and means of controlling segregation at grain boundaries in metal and ceramic alloys using Auger electron spectroscopy; densification of Al_2O_3 and MgO, creep-rupture in nickel base alloys, and corrosion of stainless steels, copper, and in inconel alloys.

MINNESOTA, UNIVERSITY OF

252. ANALYSIS OF THE DUCTILE-BRITTLE TRANSITION TEMPERATURE IN FE-BINARY ALLOYS — $ 36,335 — 01-02
W. W. Gerberich - Dept. of Chemical Engineering and Materials Science

Dislocation dynamics, crack growth, and fracture in binary Fe-base alloys above and below their ductile brittle transition temperatures and after hydrogen charging, mechanical testing acoustic emission, scanning electron microscopy, Fe alloys with Ni, Si and Pt additions, type 4340 steel for acoustic emission studies.

253. EXPERIMENTAL INVESTIGATIONS IN SOLID STATE AND LOW TEMPERATURE PHYSICS — $159,333 — 02-02
A. M. Goldman, W. V. Weyhmann, W. Zimmermann, Jr. - Dept. of Physics

Experimental investigations of superconductivity, magnetism in metals, and properties of liquid and solid helium; pair field susceptibility and specific heat of superconducting films in the transition region; nmr study of Mn_2Sb and rare-earth orthoferrites; magnetometer examination of Kondo systems; quantum properties of the flow and rotation of the superfluid component of He^4; differential osmotic pressure surface film superfluidity, and computer analysis of specific heat data of liquid He^3/He^4.

254. "IN-SITU" ELECTRON MICROSCOPE INVESTIGATION OF THE NUCLEATION AND GROWTH OF SPUTTERED THIN FILMS — $ 39,120 — 01-01
T. E. Hutchinson - Dept. of Chemical Engineering and Materials Science

Study of nucleation and growth of ion-beam sputtered thin films of highly oxidizable phases such as Nb and CdS sputtered in ultrahigh vacua; effect of residual gases on sputtered films of Nb, Si, Au, and Ag.

MONTANA STATE UNIVERSITY

255. HIGH-TEMPERATURE OXIDATION OF IRIDIUM — $ 31,440 — 01-01
R. T. Wimber - Dept. of Mechanical Engineering

Oxidation of iridium in the temperature range 1675° to 2260°C at pressures from 10^{-7} to 1.3 atmospheres of air or oxygen; kinetics of oxidation correlated with formation and mass transport through gaseous boundary layer.

NEW YORK, STATE UNIVERSITY OF

256. SLIP INITIATION AND MICRODYNAMICS OF PLASTIC FLOW — $ 49,000 — 01-02
J. C. Bilello - Dept. of Materials Science

Surface energy measurements for cleavage fracture for BCC metals; dislocation source generation and mobility as affected by impurities, phonons, solutes and other dislocations; W, Mo, Cu alloys; velocity-dependent damping coefficient measurements.

257. THEORY OF REACTION KINETICS — $ 39,000 — 02-04
J. W. Corbett and D. Peak - Dept. of Physics

Role of spatial correlation between reacting species on their reaction kinetics; recovery in discrete lattices and simultaneous production and diffusion-limited recovery; continuum theory of the role of correlation in diffusion-controlled reaction kinetics; applications to radiation damage and void formation; molecular theory of nucleation and precipitation.

258. FATIGUE-ENHANCEMENT OF DIFFUSION — $ 14,968 — 01-03
H. Herman - Dept. of Materials Science

Changes in electrical resistivity due to short-range order in alpha brass; increased ordering from enhanced diffusion caused by cyclic straining; frequency and amplitude effects; derived energies and kinetic parameters.

NORTH CAROLINA STATE UNIVERSITY

259. DIFFUSION OF GASES IN SOLIDS — $ 52,000 — 01-04
T. S. Elleman - Dept. of Nuclear Engineering

Tritium diffusion rates in metals and the influence of surface condition; bulk and grain boundary diffusion coefficients for tritium in type 304 stainless steel; surface film and bulk diffusion rates in stainless steel, Zircaloy-2 and Nb; multiregion diffusion models.

260. SORPTION OF CESIUM BY GRAPHITES AS A FUNCTION OF STRONTIUM AND BARIUM CONCENTRATION AT HIGH TEMPERATURES — $ 38,569 — 03-03
L. Zumwalt - Dept. of Nuclear Engineering

Quantitative thermodynamic aspects of the sorption behavior of volatile fission product metals in nuclear grade graphite; equilibrium vapor pressures of Cs as a function of its concentration and temperature by in-situ pseudopiestic method; temperature range of 800 to 1200°C and Cs equilibrium vapor pressures from 10^{-9} atm to 10^{-4} atm.

NORTH CAROLINA, UNIVERSITY OF

261. INVESTIGATION OF DEFECT STRUCTURES BY ELECTRIC POLARIZATION AND RELAXATION METHODS — $ 38,035 — 02-02
J. H. Crawford, Jr. - Dept. of Physics

Use of ionic thermocurrent techniques in studying the structure and reorientation mechanism of nearest neighbor and next nearest neighbor trivalent metal ion-interstitial fluoride ion complexes in alkaline earth fluorides; kinetics of complex formation upon annealing after quenching; measurement of the dipole moment and the reorientation kinetics of the F_A center in KCl:Li and Z, center in KCl:Sr.

NORTHWESTERN UNIVERSITY

262. EFFECT OF POINT DEFECTS ON MECHANICAL PROPERTIES OF METALS — $ 48,941 — 01-04
M. Meshii - Dept. of Materials Science

Point defects introduced by electron irradiation and quenching; effect of point defects on mechanical behavior of metallic single crystals; Fe, Nb; strength, yielding, stress-strain curves; diffusion annealing.

OHIO STATE UNIVERSITY

263. CORROSION, STRESS CORROSION CRACKING, AND ELECTROCHEMISTRY OF THE IRON AND NICKEL BASE ALLOYS IN CAUSTIC ENVIRONMENTS — $ 50,000 — 01-01
R. W. Staehle and A. K. Agrawal - Dept. of Metallurgical Engineering

Corrosion study of Fe, Ni, Cr and Mo alloys in caustic environments; both aqueous solutions and anhydrous fused metls will be studied in the temperature range up to 800°C; rate laws and kinetic models for general corrosion and for stress corrosion cracking; effectiveness of inorganic inhibitors.

OKLAHOMA, UNIVERSITY OF

264. THERMOELECTRIC SIZE EFFECT IN NOBLE METALS — $ 60,000 — 02-02
R. R. Bourassa - Dept. of Physics & Astronomy

Thermopower of In alloys; current decay in V and Nb rings containing helical flux line structure; superconducting Tokamak effect; thermoelectric size effect in Au and Cu; vacancy enhanced thermopower of Al.

OREGON STATE UNIVERSITY

265. NATURAL CONVECTION HEAT TRANSFER IN LIQUID METALS — $ 23,624 — 01-03
J. R. Welty - Dept. of Mechanical Engineering

Heat transfer and flow behavior of liquid metals in natural convection adjacent to heated vertical surfaces; levels of turbulence to be determined as functions of location, heat flux and channel width-to-height ratio; velocity profiles in Hg.

PENNSYLVANIA STATE UNIVERSITY

266. CERAMIC RESEARCH — $ 26,119 — 01-02
R. C. Bradt and J. H. Hoke - Dept. of Material Sciences

Transformational superplasticity in ceramics; effects of stoichiometry variations on the fracture process; characterization of superplasticity in Bi_2O_3, Bi_2O_3-Sm_2O_3, and Bi_2WO_6; fracture studies in TiO_{2-x} and $Fe_{1-x}O$.

PENNSYLVANIA, UNIVERSITY OF

267. DISLOCATION MOBILITIES IN ORDERED ALLOYS — $ 37,100 — 01-02
D. P. Pope - Dept. of Metallurgy and Materials Sciences

Dislocation velocity measurements on Cu_3Au and Ni_3Al; effect of temperature and stress; used to interpret the temperature dependence of the yield stress and the work hardening rate.

PITTSBURGH, UNIVERSITY OF

268. THERMAL, STRUCTURAL AND MAGNETIC STUDIES OF METALS AND INTERMETALLIC COMPOUNDS — $ 97,000 — 02-02
W. E. Wallace and R. S. Craig - Dept. of Chemistry

Electronic specific heat coefficient for alloys of the pseudobinary system Y_6Fe_{23}-Y_6Mn_{23}; magnetization versus temperature and magnetic field for R. E. Co_3 and R. E. Co_5 systems; enthalpies of formation of selected intermetallic compounds; photoelectron spectroscopy studies; intermetallics as hydrogen absorbers.

PURDUE UNIVERSITY

269. TRANSPORT AND THERMODYNAMIC PROPERTIES OF SOLIDS — $ 36,000 — 01-03
R. E. Grace - School of Materials Engineering

Atomic diffusion and interfacial stability in solid multicomponent, multiphase alloys; intrinsic and interdiffusion coefficients in Ni-Al, Cu-Zn-Ni, Fe-Ni-Al; electron microprobe analysis and scanning electron microscopy.

RENSSELAER POLYTECHNIC INSTITUTE

270. THE EFFECT OF WELDING VARIABLES ON THE SOLIDIFICATION SUBSTRUCTURE, MECHANICAL PROPERTIES AND CORROSION BEHAVIOR OF AUSTENITIC STAINLESS STEEL WELD METAL — $ 35,000 — 01-01
W. F. Savage and D. J. Duquette - Materials Division

Type and severity of microsegregation of both austenite and ferrite stabilizers; measured mechanical properties at room and elevated temperatures; static corrosion and stress corrosion cracking; studies using simulated welding conditions.

271. FATIGUE BEHAVIOR OF BCC METALS — $ 29,300 — 01-02
N. S. Stoloff - Dept. of Materials Engineering

Fatigue behavior of V and V-H alloys under high cycle (stress controlled) and low cycle (strain controlled) conditions; nucleation sites and propagation paths of fatigue cracks to be determined; studies at room temperature.

ROCHESTER, UNIVERSITY OF

272. THE MATERIALS AND MECHANICS OF RATE EFFECTS IN BRITTLE FRACTURE — $ 35,000 — 01-02
S. J. Burns - Dept. of Mechanical & Aerospace Sciences

Wedged double cantlevered beam specimen to measure the critical stress intensity factor K_{IC} for a steel with different grain sizes; tested at different temperatures, the length of the crack measured electrically; emphasis on the brittle region of fracture.

273. DIFFUSIONAL CREEP OF MULTI-COMPONENT SYSTEMS — $ 25,908 — 01-02
J.C.M. Li - Dept. of Mechanical and Aerospace Sciences

Analyze available creep data indicating two or more simultaneous processes; measure penetration creep for single crystals of one and two components; mechanisms of diffusional creep of multi-component systems; extraction of self diffusion data for systems where radioactive isotopes are not available or inconvenient.

SOUTHERN CALIFORNIA, UNIVERSITY OF

274. GRAIN BOUNDARY SLIDING DURING HIGH-TEMPERATURE CREEP — $ 40,000 — 01-02
T. G. Langdon - Dept. of Materials Science and Mechanical Engineering

Study of the dependence of grain-boundary sliding on stress, temperature, grain size, and crystalline structure of fcc and hcp alloys; deformation mechanism napping.

STANFORD UNIVERSITY

275. STRUCTURE DEPENDENCE OF HIGH TEMPERATURE DEFORMATION OF METALS — $ 51,817 — 01-02
C. R. Barrett and W. D. Nix - Dept. of Materials Science and Engineering

Investigations of the kinetics of cavity growth during, and the effects of precipitate free zones and of gas bubble on high temperature creep; effects of stacking faults on recovery kinetics; structure and properties of ultra-fine grained refractory metals produced by physical vapor deposition.

276. DIFFUSION OF OXYGEN IN LIQUID METAL SYSTEMS — $ 36,000 — 01-03
D. A. Stevenson - Dept. of Materials Science

Diffusion of oxygen in liquid Ga-In alloys at elevated temperatures and low oxygen pressures using electrochemical techniques employing solid oxide electrolytes.

TENNESSEE, UNIVERSITY OF

277. APPLICATION OF ADIABATIC CALORIMETRY TO METAL SYSTEMS — $ 27,000 — 01-03
E. E. Stansbury and C. R. Brooks - Dept. of Chemical and Metallurgical Engineering

Heat capacity measurements of metals, liquid Pb and Bi up to 1300°K, liquid Ga, deformed stainless steel.

TENNESSEE, UNIVERSITY OF (Continued)

278. MICROSTRUCTURE-PROPERTY RELATIONSHIPS IN AUSTENITIC STAINLESS STEELS — $ 30,000 — 01-01
J. E. Spruiell - Dept. of Chemical and Metallurgical Engineering

Investigation of microstructural stability at elevated temperatures of titanium modified stainless steels and stainless steel weldments; development of x-ray and other microstructural characterization techniques for stainless steels.

UTAH, UNIVERSITY OF

279. POSITRON LIFETIME MEASUREMENTS AS A NONDESTRUCTIVE TECHNIQUE TO MONITOR FATIGUE DAMAGE — $ 32,000 — 01-02
J. G. Byrne - Div. of Materials Science and Engineering

Measurement of positron lifetimes associated with several microstructural features such as irradiation-induced voids, stacking faults, line and point defects associated with mechanical (fatigue) damage, and hydrogen embrittlement in Cu, Ni, and Ni-66.5% Co.

280. IMPURITY EFFECTS ON THE CREEP OF POLYCRYSTALLINE MAGNESIUM AND ALUMINUM OXIDES AT ELEVATED TEMPERATURES — $ 29,163 — 01-02
R. S. Gordon - Materials Sciences and Engineering Division

Steady state and transient high temperature creep studies of hot pressed, dence, Al_2O_3 and MgO doped with transition metals; role of impurities, lattice defects, grain structure on relative importance of creep mechanisms of grain boundary sliding vs dislocation motion.

VERMONT, UNIVERSITY OF

281. THERMODYNAMIC AND TRANSPORT PROPERTIES OF INTERSTITIAL HYDROGEN ISOTOPES IN METALS SYSTEMS — $ 18,535 — 02-03
J. S. Brown - Dept. of Physics

Investigation of electronic and transport properties of fee transition metals, such as Pt, Pd and Ni; resistivities, thermopowers, resistance anomalies, resonant d-wage theories in liquid transition metals, development of a CPA theoretical description of electron propagation in a random interstitial ternary alloy.

VIRGINIA, UNIVERSITY OF

282. ELECTRONIC PROPERTIES OF METALS AND ALLOYS AND MOLECULES — $ 79,796 — 02-02
R. V. Coleman - Dept. of Physics

Measurement and analysis of electronic properties such as resistance, magnetoresistance, Hall effect, and de Haas van Alphen effect of solids; superconductivity in layer structures such as $NbSe_2$, TaS_2, and $NbTe_2$, and in doped layered structures; virbrational modes in molecules using inelastic electron tunneling techniques.

WASHINGTON, UNIVERSITY OF

283. MOSSBAUER STUDIES AT HIGH PRESSURE — $ 35,000 — 02-02
R. L. Ingalls - Dept. of Physics

Measurement of Mössbauer effect in invar (Ni-Fe alloy), stainless steel, and FeF_2 under pressure up to 300 Kbar; effect of internal magnetic field, isomer shift, and phase changes in transition metals.

284. A STUDY OF PHASE TRANSFORMATIONS AND SUPERCONDUCTIVITY — $ 41,000 — 01-03
D. H. Polonis - Dept. of Mining, Metallurgical and Ceramic Engineering

Study relating omega phase formations to superconductivity of binary and ternary beta stabilized Ti- or Zr-base alloys; effect of lattice misfit strain, plastic deformation and temperature, on the rate of formation and distribution of the omega phase and in turn on H_c, J_c, and flux stability; dispersion of particles having the A-15 structure in another matrix alloy.

WISCONSIN, UNIVERSITY OF

285. VOID NUCLEATION AND GROWTH IN HEAVY ION AND ELECTRON BOMBARDED PURE METALS — $ 45,030 — 01-04
G. L. Kulcinski - Dept. of Nuclear Engineering

Study of nucleation and growth of radiation induced voids in Pure Al and V; ion and electron radiation; use of H- or He-doped alloys to determine role of these impurities in void nucleation.

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, 1974, the Materials Sciences Program's total support level amounted to about $32.1 million in operating funds and $1.1 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 $32.1 million operating funds.

1. By Region of the Country:

	Contract Research (%)	Total Program (%)
(a) Northeast (Mass., R.I., Penn., N.Y., N. H., D.C., Md., Vt., Conn.)	44.5	18.8
(b) South (Fla., N.C., Tenn., Va.)	7.0	22.6
(c) Midwest (Ohio, Ill., Wisc., Mich., Minn., Ind., Iowa, Kan.)	21.1	43.6
(d) West (Ariz., Utah, Calif., Colo., Mont., Okla., Ore., Texas, Wash., Hawaii, N.Mex.)	27.4	15.0

2. By Academic Department or Laboratory Division:

	Contract Research (%)	Total Program (%)
(a) Metallurgy, Materials Science, Ceramics (Office Budget Activity Numbers 01-)	57.5	40.2
(b) Physics, Solid State Science, Solid State Physics (Office Budget Activity Numbers 02-)	38.1	43.0
(c) Chemistry, Chemical Eng. (Office Budget Activity Numbers 03-)	4.4	16.8
	100.0	100.0

SUMMARY OF
FUNDING LEVELS

3. By AEC Laboratory and University:

	Total Program (%)
(a) University Program (including those laboratories where graduate students are involved in research to a large extent)	39.4
(b) Laboratory Program	60.6
	100.0

4. By Laboratory:

	Total Program (%)
Ames Laboratory	11.3
Argonne National Laboratory	24.6
Brookhaven National Laboratory	12.0
Illinois, University of (Materials Research Laboratory)	4.1
Lawrence Berkeley Laboratory	8.5
Los Alamos Scientific Laboratory	0.3
Mound Laboratory	0.3
Oak Ridge National Laboratory	21.5
Pacific Northwest Laboratory	2.0
Contract Research	15.4
	100.0

SUMMARY OF
FUNDING LEVELS

5. By Selected Areas of Research:

	Number of Projects (Total=227) (%)	Total Program $ (%)
(a) Materials		
Actinide Metals and Compounds	9.3	5.9
BCC Refractory Metals	20.2	9.2
Ceramics	18.5	11.0
Rare Earth Metals and Compounds	11.9	7.5
(b) Technique		
Neutron Scattering	7.5	18.2
Theory	6.6	6.9
(c) Phenomena		
Diffusion	12.4	4.7
Strength	18.9	8.7
Superconductivity	10.6	7.9
Surface Phenomena and Thin Films	12.8	7.6
Void Formation	5.7	3.6
(d) Environment		
High Pressure	4.0	1.9
Hydrogen	3.1	1.3
Radiation	13.2	16.0

SECTION D

Index of Investigators, Materials, Phenomena, Technique and Environment

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

INVESTIGATORS

INVESTIGATORS

INVESTIGATORS

INVESTIGATORS

INVESTIGATORS

INVESTIGATORS

Actinide Metals and Compounds

1	103
2	106
3	107
23	108
24	111
37	112
41	113
42	128
43	141
44	237
46	

Ceramics

Carbides	Glass	Nitrides	Oxides			
46	10	46	2	33	111	201
52	91	52	4	43	114	239
81		107	5	46	115	241
107		114	22	52	121	242
111		138	23	66	122	243
138			25	91	123	248
221			26	92	124	251
228			27	94	135	266
			31	107	140	280

Composites

4
71
85
89
90
108
113
210
238

Graphite and Carbon

32
60
64
90
260

Intermetallic Compounds

3	116
8	118
25	127
32	141
38	204
54	208
55	245
56	246
57	267
69	268

Ionic Crystals

Alkali Halides

33	227
35	228
64	229
114	261
212	

Other

19	214
21	227
32	236
40	248
41	249
121	261
125	282
126	

Liquids

10	133
18	134
20	209
47	217
49	218
53	247
60	253
62	265
95	276
106	277

Metals

Alkali

47
50
78
80
219
228

BCC Refractory

1
2
3
5
6
10
16
23
27
29
47
54
61
67
70
73
74
78
110
112
113
114
115
116
117
121
123
127
129
142
211
213
215
221
223
224
233
235
244
254
256
262
263
271
275
285

Ferrous

4
68
77
84
85
87
99
114
117
119
120
128
202
203
213
217
223
229
251
252
259
262
263
270
272
277
278
283

Organics

17
133
236

Rare Earth Metals and Compounds

3
4
6
7
12
15
22
25
28
32
33
34
37
41
59
107
108
118
119
121
128
201
207
229
249
253
268

Acoustic Emission

72
229
240
252

Auger Spectroscopy

1
105
124
251

Computer Simulation

26
128
206
232
245

Elastic Constants

27
76
129
228
235

Electron Microscopy

30
31
84
110
117
131
142
202
213
215
222
232
245
252
254

Electron Spin Resonance

14
35
38
125
126

Field Ion Microscopy

22
222

High Temperature Heat Capacity

43
44
52
277

Infrared Spectroscopy

43
48
94
135
227

Internal Friction

70
76
81
106
211
244

Laser Beam Scattering

79
94
95
214
218
247

Low Temperature Specific Heat

3
34
46
56
97
208
268

Magnetic Susceptibility

7
24
68
202
204
207
229
253
268

Mossbauer Effect

24
37
77
212
283

Neutron Scattering

4
6
13
25
32
41
57
58
59
60
66
118
119
120
133
246
247

Nuclear Magnetic Resonance

8
14
23
38
75
80
104

Optical Absorption

11
64
125
236
261

Positron Annihilation

27
64
279

Sputtering

10
141
254

Theory

7
11
23
39
63
87
96
109
128
134
216
225
257
273
281

Thermal Conductivity

115
219
239
265

X-Ray Scattering

13	82
16	111
23	124
25	131
26	201
38	249
42	278
44	

Channeling

30
65
128
130

Crystal Structure, Atomic Distribution and Crystal Transformations

4	49	84	133	246
8	52	99	140	247
13	58	106	141	248
21	60	107	201	249
25	63	110	202	266
38	66	111	204	268
41	67	119	209	270
42	75	120	225	283
48	77	123	235	284

Diffusion

4	41	114	258
5	50	134	259
20	70	137	265
27	78	219	269
31	91	241	273
32	98	247	276
38	103	257	281

Dislocations

26
76
86
109
211
220
267

Electron Transport

1	122
10	123
24	129
34	140
39	207
78	230
81	243
99	264
115	282

Electronic Structure

Fermi Surface	Other	
7	23	78
23	24	80
37	39	94
96	63	109
	68	128
	77	231

Magnetism

3	57	119
4	62	128
7	63	207
14	66	209
23	68	212
24	80	229
25	90	246
32	97	253
37	99	268
39	104	283
41	118	

Materials Preparation and Characterization

1	121
12	138
15	139
17	228
19	248
33	275
101	
108	

Phonons

6	95
10	115
32	118
45	128
58	214
59	227

Point Defects

27	125
29	126
30	131
35	132
40	140
63	142
64	206
78	222
79	237
82	239
86	261
109	262
124	

Precipitation

18	75
31	110
47	205
52	213
73	221
74	232

Recovery and Recrystallization

35	202
40	277
112	278
142	

Sintering

4
44
83
92
242
248

Solidification

4

Strength

Fracture		Fatigue	Creep	Flow Stress		
2	203	26	26	1	107	240
26	223	258	31	2	112	244
72	238	271	141	26	141	245
86	251	279	273	69	205	251
90	252		274	71	211	256
92	266		275	74	220	262
112	272		280	85	226	266
				87	228	267
				91	233	

Stress-Corrosion Cracking

72
252
263
270

Superconductivity

3	23	39	61	97	204
8	28	54	89	116	208
9	32	55	93	127	224
17	36	56	96	141	284

Surface Phenomena and Thin Films

1	105	234
11	113	236
22	124	250
38	131	251
50	135	253
52	136	254
88	139	255
98	212	259
102	217	260
103	218	

Void Formation

5	206
29	213
31	215
111	216
117	257
120	285
205	

Gas

Oxidizing		Hydrogen
15	2	72
73	27	73
113	32	223
139	70	
140		
201		
243		
255		
276		

Magnetic Field

3	57
4	68
7	75
8	80
14	104
24	118
34	119
37	207

Pressure

Above Atmospheric
10
32
77
78
99
228
235
242
283

Radiation

Electron	Ion		Neutron		Theory	Gamma
30	29	124	5	131	63	56
31	30	130	29	132	128	64
40	31	132	40	142	216	
56	40	142	56	202	257	
64	56	205	117	215		
82	64	222	124	244		
117	65	237	129			
125	86	244				
129	117	285				
213						
285						

Temperature

Below Liquid Helium (4.2°K)

9	97
10	209
28	227
34	234
46	239
62	253
93	268

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