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Part II

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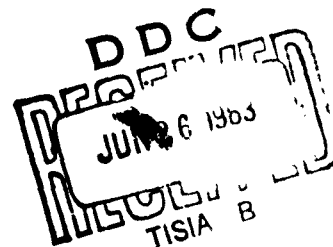
**ELECTRICAL AND ELECTRONIC PROPERTIES
OF MATERIALS
INFORMATION RETRIEVAL PROGRAM**

TECHNICAL DOCUMENTARY REPORT NO. ASD-TDR-62-539, Part II

April 1963

Directorate of Materials and Processes
Aeronautical Systems Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

Project No. 7381, Task No. 738103



(Prepared under Contract No. AF 33(616)-8438
by the Hughes Aircraft Company, Culver City, California
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FOREWORD

This report was prepared by Hughes Aircraft Company under Contract No. AF 33(616)-8438. This contract was initiated under Project No. 7381, Task No. 738103. The work was administered under the direction of the Directorate of Materials and Processes, Aeronautical Systems Division, with Mr. R. F. Klinger acting as project engineer.

This report covers work conducted from June 15, 1962 through December 14, 1962. The Contractor's Report Number is P63-15.

Many persons have contributed to the making of this report and the development of the program which it reflects. In addition to the authors, the most important contributors were:

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ABSTRACT

A documentation system has been established for abstracting, indexing, and retrieving data relative to the electrical and electronic properties of materials. That data and the literature are retrieved through a modified manual coordinate index highly adaptable to machine usage. Publications include data sheets, thesauri, property tables, and summary reviews. Methods and routines of the system have been described in the first final report, Technical Documentary Report No. ASD-TDR-62-539. This, the second final report, covers the additional effort expended during the first extension of the contract. Appended are a consolidated list of electrical and electronic properties and lists in the following categories of materials: Electroluminescent Materials, Thermionic Emitters, Ferroelectrics, Ferrites, Ferromagnetics, Super-conductors and Metals.

This technical documentary report has been reviewed and is approved.

D. A. Shinn
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I. INTRODUCTION

The exponential growth of research in recent years has brought with it what is commonly called the 'literature explosion. Although along with it have been informational problems that have plagued all areas of the physical and natural sciences, nowhere is the rise in generation of literature more evident than in electronics and its applications. When the transistor was invented in 1948, the whole area of solid state physics was stimulated, leading to developments that have evolved so fast that sometimes it seems impossible to say which came first, the theory or the new material.

Actually the accomplishment of technical endeavor would seem to be a process dependent first upon theoretical concept and later upon application. However, especially in the field of materials research, current effort often provides answers ahead of the problems, for creative empiricism appears frequently to lead theory. In general, one is forced to resort to the somewhat labored work of understanding before any final truth emerges.

Understanding this, the Directorate of Materials and Processes, Aeronautical Systems Division, has contracted the establishment of a program to collect, index and abstract the literature on the electrical and electronic properties of materials and to evaluate and compile the experimental data from this literature.

The program was initiated in June 1961 with the intention of covering ten major categories of materials: Semiconductors, Insulators, Ceramics, Ferroelectrics, Metals, Ferrites, Ferromagnetics, Electroluminescent Materials, Thermionic Emitters and Superconductors.

During the first year, a Phase I, study, and Phase II, implementation, was accomplished in the categories of Semiconductors and Insulators. During the six months covered by this report, the documentation effort has continued in these two categories and indexing-vocabulary studies have been tentatively established on Ferroelectrics, Metals, Ferrites, Ferromagnetics, Electroluminescent Materials, Thermionic Emitters and Superconductors. Ceramics has been discontinued as a separate category and is being subsumed under the other nine.

This report details the efforts during the six-month extension to the program from June 15, 1962, to December 14, 1962. The original routines, procedures and concepts of the program have been previously published in the final report for the first year of work. (ASD-TDR-62-539).

Manuscript released by the authors December 1962 for publication as an ASD technical documentary report.

II. DOCUMENTATION

Documentation comprises searching, acquiring, abstracting and indexing the literature. Establishment of a documentation system required studies to develop an appropriate vocabulary for material and property names and an indexing scheme capable of storing, identifying and rapidly retrieving the literature. It was thought desirable to develop an index both flexible and highly specific which would be contained in the final report for the first year. methods of storage and retrieval.

The index as finally adopted can be called a modified coordinate index. The system, the philosophy behind the adoption of it, and a description of the punched card program for posting the descriptors is contained in the final report for the first year.

A. Searching the Literature

Since the beginning of the program, 6100 accession numbers have been assigned, representing almost that many items abstracted and indexed. This has involved searching over 50,000 titles, abstracts, or indexed entries up to the end of the report period.

Searching in the two categories of Semiconductors and Insulators can be said to be virtually complete. It has now broadened out from the usual, more remunerative sources into many of the more obscure sources. During the first year of the program it was largely concentrated in the following sources:

- ASTIA Technical Abstract Bulletin
- Ceramic Abstracts
- Chemical Abstracts
- Digest of Literature of Dielectrics
- Engineering Index
- Electrical Engineering Abstracts
- Physics Abstracts
- Semiconductor Abstracts
- Semiconductor Electronics
- Solid State Abstracts
- U. S. Government Research Reports

At the present time, the searching in these two categories includes direct review of periodicals not indexed in these sources, primarily by

citation following. Plans have also been laid for a systematic searching of the literature in the other seven categories and searching has begun. It is anticipated that a smaller percent of the articles in these categories can be readily searched in abstracting and indexing services and more will have to be searched through such techniques as use of citations. The proportion of lost effort will thus increase and for every piece of literature indexed into the system, a greater amount of time will be absorbed.

The period from June 15, 1962, to December 14, 1962, has been occupied in completing documentation as well as retrospective searching of literature for Semiconductor and Insulator materials to the year 1940. Although journals from the years 1940 to 1945 yielded valuable papers, the subject specialists and evaluators preparing data sheets showed strong preference towards data taken from 1955-1962 papers which reflect the most meaningful work and the latest instrumentation. Some materials, such as Silicon, inspired hundreds of papers containing data and studies so that the evaluator has faced a significant concern in choosing the best.

It may be well to consider here the impact of much literature as compared with pure data. In the acts of searching and abstracting, papers are found with all degrees of technical and scientific effort. In attempting to assay these works, the tendency is to include most everything on the grounds that it may be useful to a given user. He needs a wider range to build his case and is not satisfied with only single points clearly defined. A problem arises, of course, as with the limitations of any system selection of lists and names fails to account for the ones which may use non-standard symbols, compound names or author originality. Including these types of literature aggravates the false drop likelihood and yet papers such as these are selected after careful evaluation because they appear to have useful or significant data.

Our search efforts have definitely widened and methods have been introduced which have led to an even better coverage of the existing literature. The results can be seen from the following data (covering Semiconductor and Insulator materials only). It is felt that future activity in the added categories of materials contemplated will benefit from our added capability.

For sources of relevant information, we have screened the following abstract-indexes to the extent indicated. Search continues on the current input of technical literature by searching current issues and on the later issues not covered.

	<u>Volumes</u>	<u>Period Covered</u>
Solid State Abstracts	1-3	
(Semiconductor Electronics)		Jan. 1952-Sept. 1962
(Battelle Abstracts of	-	
Semiconducting Materials)		

	<u>Volumes</u>	<u>Period Covered</u>
Science Abstracts, A. Physics	43-65	1940-Sept. 1962
B. Electrical Engineering	43-65	1940-Sept. 1962
Chemical Abstracts	44-57	1947-June 1961
Technical Abstract Bulletin (ASTIA)	-	to May 1962
Ceramic Abstracts (American Ceramic Society)	33-45	1950-Oct. 1962
Applied Science and Technology Index	-	1958 - 1960
Engineering Index	-	1945 - 1961
Digest of Literature on Dielectrics	-	1957 - 1960
Resins, Rubber, Plastics Yearbooks	-	1957 - 1959
U. S. Government Research Reports	11-37	1949-April 1962

Another very productive source is an internal one in which references from the bibliographies of acquired articles are checked against the author index and information not already in the system is then searched for pertinent data.

In addition to the abstract-indexes, 26 of the most productive journals are being completely searched and selected articles checked against previous acquisitions to prevent duplications.

An analysis of the search activities in the two categories of Semiconductors and Insulators has yielded some interesting and useful information. For example, 6 percent of the sources which we have used have yielded 80 percent of our acquisitions. The source index file now includes 467 separate sources. Sixty sources have yielded 20 or more acquisitions each. Total pieces indexed at the time of the analysis were 5700.

Included in the analysis were articles covering 312 Semiconductor materials, 29 Semiconductor properties, 475 Insulator materials, and 12 Insulator properties. The 103 most productive sources in decreasing order of yield (to November 1962) are listed below. There have been 363 additional sources indexed which have yields of less than five articles each. The total articles acquired per source is in parenthesis.

1. Physical Review (940)
2. Technical Documents received from ASTIA (550)
3. Journal of Applied Physics (510)
4. Soviet Physics - Solid State (350)

5. American Physical Society, Bulletin (275)
6. Physical Society, Proceedings (244)
7. Physical Society of Japan, Journal (212)
8. Physics and Chemistry of Glasses, Journal (210)
9. Soviet Physics – Technical Physics (180)
10. Journal of Chemical Physics (150)
11. Academie des Sciences (Paris), Comptes Rendus (125)
12. Soviet Physics – Doklady (108)
13. Physica (100)
14. Zeitschrift für Naturforschung (90)
15. Electrochemical Society, Journal (85)
16. Nature (80)
17. American Institute of Chemical Engineers, Transactions (75)
18. Electrical Manufacturing (70)
19. Physical Review Letters (65)
20. American Ceramic Society, Journal (60)
21. Zeitschrift für Physik (50)
22. American Institute of Electrical Engineers, Proceedings (50)
23. Soviet Physics – JETP (46)
24. Optika i Spectroskopiia (45)
25. Canadian Journal of Chemistry (44)
26. Helvetica Physica Acta (42)
27. Czechoslovak Journal of Physics (40)
28. Dow Corning Corporation, Technical Publications (40)
29. Indian Journal of Physics (40)
30. Industrial and Engineering Chemistry (40)
31. Optical Society of America, Journal (40)
32. Royal Society of London, Proceedings (40)
33. Semiconductors and Phosphors (Proceedings of the International Colloquium held at Garmish-Partenkirchen, 1956) (40)
34. Institution of Electrical Engineers (London), Proceedings (38)
35. Materials in Design Engineering (35)
36. Insulation (34)

37. IRE Proceedings (34)
38. Journal of Electronics and Control (32)
39. Annalen der Physik (30)
40. American Chemical Society, Journal (30)
41. British Journal of Applied Physics (30)
42. Philips Research Reports (30)
43. Academy of Sciences of the USSR, Bulletin (25)
44. Canadian Journal of Physics (25)
45. Conference on Electrical Insulation, Annual Reports (25)
46. Elektrichestvo (25)
47. Elektrotechnik Zeitschrift (25)
48. Faraday Society, Transactions (25)
49. Journal of Electronics (25)
50. Modern Plastics (25)
51. National Bureau of Standards, Journal of Research (25)
52. Photoconductivity Conference, Atlantic City, 1954 (25)
53. Wire and Wire Products (25)
54. Zeitschrift für Physikalische Chemie (Frankfort) (23)
55. Zeitschrift für Angewandte Physik (22)
56. American Ceramic Society, Bulletin (21)
57. Journal of Physical Chemistry (20)
58. Naturwissenschaften (20)
59. Physica Status Solidi (20)
60. Product Engineering (20)
61. Solid State Physics in Electronics and Telecommunications (19)
62. Bell System Technical Journal (18)
63. British Intelligence Objectives Sub-Committee, Reports (17)
64. Electrical Engineering (17)
65. Zhurnal Tekhnicheskoi Fiziki (17)
66. Society of Glass Technology, Journal (16)
67. Tohoku U., Science Reports of the Research Institutes (16)
68. Journal of Polymer Science (15)

69. Kolloid Zeitschrift (15)
70. Journal de Chimie Physique (15)
71. Materials and Methods (15)
72. Review of Scientific Instruments (15)
73. Zeitschrift fur Elektrochemie (15)
74. Institution of Electrical Engineers, Journal (London) (14)
75. British Electrical and Allied Industries (13)
76. Ceramic Age (13)
77. Connecticut Hard Rubber Company (13)
78. RCA Review (13)
79. Revue Generale de L'Electricite' (13)
80. ASTM Bulletin (12)
81. Akademiia Nauk SSSR. Instut Kristallografii. Trudy (11)
82. Electronics (11)
83. Faraday Society, Discussions (11)
84. Kunststoffe (11)
85. Optics and Spectroscopy (11)
86. Resins, Rubbers, Plastics Yearbook (11)
87. Electronic Engineering (10)
88. General Electric Company. Silicone Products Department Reports (10)
89. Applied Scientific Research (9)
90. Ceramic Industry (9)
91. Electrical Review (9)
92. Electrochemical Society, Transactions (9)
93. General Electric Review (9)
94. Progress of Theoretical Physics (9)
95. Rubber Age (9)
96. Union Carbide and Carbon Corporation, Data Sheets (9)
97. Research (8)
98. Reviews of Modern Physics (8)
99. Sylvania Technologist (8)
100. Abhandlungen der Braunschweigischer Wissenschaftlichen Gesellschaft (7)

101. Acoustical Society of America, Journal (6)
102. Annales de Physique (5)
103. Archiv für Physik (5)

The system content is being continually upgraded as a result of the evaluation and compilation efforts of high technical level personnel. Eliminated in the process are, (1) acquisitions of doubtful value, (2) errors in classification and (3) duplications. Subsequent replacement runs of descriptor cards reflect those corrections.

Favorable experience with the modified coordinate index system indicates that it is well suited for the variety and volume of reference material to be used. Current searching involves electronic data on 29 properties of 312 Inorganic and 250 Organic Semiconductor materials. Similarly sought is data on 12 electronic properties of 475 Insulator materials and searching has begun on the 7 additional categories of materials for the ensuing contract.

Boundary specifications for search in new fields such as these are very difficult to establish. It is expected that a better knowledge of user requirements will enable us to improve the quality of our output by tightening the specifications.

In general, the newer articles are more specialized but carry more reliable data because of recent refinements in materials analysis. Therefore, future searching will require a closer analysis of the abstracting and the possible addition of properties only now becoming important.

B. Indexing and Abstracting

Few changes have been made in the routines of indexing and abstracting. These routines, as reported in the final report for the first year, are working competently and adequately. Work instead has been concentrated on aids to the index in the way of improved lists of indexing vocabularies and definitions and delineation of terms, synonyms and cross-references. To this end, work is continuing on the glossary as appended to the first final report.

One important addition to the routines of the system has been the use of a Change or Addition Notice (Figure 1). This form is used for any recommended change or addition and can be filled out by anyone working on the program. It is used for such varied additions and changes as adding new materials and properties, changes in routines, correcting of errors occurring in routine activities, and suggested re-indexing of articles into new categories.

All routines have now been established for indexing and abstracting in the new categories of materials. The index-abstract forms as

now in use, appear as Figures 2 through 10. They are so arranged that the indexer-abstractor can write the materials appearing in an article down the left hand column and check the appropriate property. The properties that appear on each form are those usually considered as falling within that category of materials. Spaces are left to allow write in of other properties.

CHANGE OR ADDITION NOTICE - Electronics Properties Center

<u>Operations Procedure</u>		PROBLEM: _____
Searching	☐	_____
Acquisition	☐	_____
Indexing	☐	_____
Abstracting	☐	_____
Evaluation	☐	_____
Data Sheets	☐	PROPOSED SOLUTION: _____
Publications	☐	_____
<u>Priority</u>		_____
Originator	☐	_____
Project Leader	☐	_____
Change Requested By _____		_____
(Signature)		(Date) (Accession No. if involved)
Change Authorized By _____		_____
Signature (Project Leader)		(Date)
Change Introduced into EPC System _____		_____
(Date)		

Figure 1. Change or Addition Notice.

AF33(616)-8438 Index - Abstract Form
Name: _____ Hours: _____ Date: _____
Revised October 1962

12

[illegible]

AF33(616)-8438 Index - Abstract Form

Revised October 1962

Figure 3. Index-Abstract Form-Ferrites

ELECTROLUMINESCENT MATERIALS	
	Absorption
	Carrier Diffusion
	Cross Sections
	Dielectric Constant
	Dielectric Strength
	Electrical Conductivity
	Excitation
	Energy Bands
	Energy Gap
	Energy Levels
	Irradiation Effects
	Lifetime
	Luminescent Efficiency
	Magnetic Susceptibility
	Magnetoelectroluminescent Properties
	Mobility
	Photoelectroluminescent Properties
	Photoconductive Properties
	Piezoelectronic Properties
	Surface Properties
	Thermoelectroluminescent Properties
	Work Function

AF33(616)-8438 Index - Abstract Form
Name: _____ Hours: _____ Date: _____
Revised October 1962

Figure 6. Index-Abstract Form-Electroluminescent Materials.

SEMICONDUCTOR MATERIALS	
	Acoustical Properties
	Carrier Diffusion
	Cross Sections
	Debye Temperature
	Dielectric Constant
	Effective Mass
	Electrical Conductivity
	Electroacoustic Properties
	Emission
	Energy Bands
	Energy Gap
	Energy Levels
	Hall Coefficient
	Irradiation Effects
	Lifetime
	Magnetic Susceptibility
	Magnetoelectric Effects
	Mobility
	Photoelectric Effects
	Plasmonic Properties
	Reflection
	Refractive Index
	Surface Properties
	Thermal Conductivity
	Thermoelectric Properties
	Work Function

AF33(616)-8438 Index - Abstract Form

Revised October 1962

Figure 9. Index-Abstract Form-Semiconductors.

III. DATA COMPILATION AND EVALUATION

Since the beginning of the program, the compilation-evaluation of data has been one of the most difficult and crucial parts. As the literature has accumulated, it has been examined for its completeness within the field of the individual material being worked upon. In general, the most technically promising materials have been chosen first for evaluation and compilation after the literature has been judged complete within this area. The value of the results has depended upon the adequacy of the data as presented in the literature and upon the skill and knowledge of the subject specialist doing the work. Judgments have had to be made concerning the adequacy and comparative merits of experimental results, and the most probable values have had to be sought and chosen.

As much as possible, the information presented in the literature has been extracted. When not possible, the data has been synthesized, sometimes from several articles. In general, evaluation has been confined to primary source data except when only secondary citations have been available. If equally valid data has been available from more than one investigation, all are given. However, data are rejected when judged questionable because of faulty or dubious measurements, unknown sample composition, or if more reliable data are available from another source. Selection of data has been based upon that which is judged most representative, precise, and reliable, covering the widest range of variables. The addition of new data to a previously evaluated property requires a re-appraisal of the reported values and older data has been deleted if the new data has been judged to be more accurate or representative. During the course of the program, the quality of presentation in the data sheets has been improved to reflect suggestions made from both within the program group and outside of the group including the customer. The sheets have been expanded to include more data, and studies have been undertaken to present a more uniform selection. In addition, new equipment has been obtained to enable us to present the information surrounding the data sheet in a more uniform manner.

It is interesting to note the difference in compiling data sheets in the Semiconductor category and in the Insulator category. As we began to compile data in the Insulator category, these differences became noticeable. In contrast to the precise sample preparation in semiconductors with perhaps one part per million of impurity, Silicone Rubber, for example, requires format and detailed presentation which takes into consideration that industrial material is most often a batch. Quality control of such batches is adequate for its intended use, but raw materials and processing vary enough to make it necessary to show both them and the source of the ingredients in order to evaluate the measurement data for the applications engineer.

By this time it has become highly apparent that reducing the data to useful and workable data sheets requires great skill and knowledge. It is essential that objectives be formulated. Intelligent data compilation depends directly on the use to be made of it and the type of user. Current state of the art from all aspects must influence the choice of data, and since the evaluator cannot possibly be acquainted with all aspects, materials specialists, research scientists, and applications engineers must be available for consulting. Considerable work by the evaluator is necessary in rounding out an author's references and intentions. Experience, and even intuition frequently play an important part in weeding out incomplete works and selecting the best. Such parameters as symbols must be made understandable and as uniform as practical to assist the user in spite of the great degree of variance in these parameters as they appear in the literature. Data work sheets are used to compile the data in order that it might be reviewed for accuracy and completeness before being processed for data sheet layout. The data appear primarily as curves or in tabular form but they are not limited to these forms since it is felt that they must be presented in the optimum way. Where possible, graphs are adapted directly from the original sources. If this is not possible, they may be drawn from data compiled from the articles. In final form there is now an average of about 30 data sheets issued for each of the materials completed.

In evaluating the data and compiling it into data sheets technical problems lay in the areas of symbols, terminology, definitions, poor presentation of data and even poor writing. An interesting example has been the difference between a coefficient and a constant. This is frequently obscure. The property called dielectric constant is really a misnomer, it being subject to change by various parameters, for example, temperature, frequency and pressure. One article with valuable data detailed a fine, well-controlled experiment exhibited adequate presentation of the data, and then failed to give the name of the material involved in the experiment.

The following chart gives total information as to the number of data sheets issued or in process of being compiled, the number of properties for the materials involved, the number of pages of data sheets and the date of issue. The chart gives the status of these data sheets as of December 15, 1962.

<u>Semiconductors</u>	<u>Number of Properties</u>	<u>Number of Pages</u>	<u>Date of Issue</u>	<u>Status 15 Dec 62</u>
Indium Phosphide	17	24	June 1962	
Magnesium Selenide	5	9	June 1962	
Indium Telluride	10	22	June 1962	
Zinc Telluride	11	19	June 1962	
Cadmium Telluride	17	44	June 1962	
Indium Arsenide	23	52	July 1962	
Gallium Phosphide	14	18	Sept 1962	
Aluminum Antimonide	18	38	Sept 1962	
Magnesium Stannide	14	18	Oct 1962	
Lead Telluride	18	30	Oct 1962	
Gallium Antimonide	23	47	Oct 1962	
Gallium Arsenide				Final Review
Lead Selenide				Final Review
Zinc Oxide				Compiled
Silicon	1	29	Dec 1962	
Silicon	12	50		Evaluated

Insulators

Polyethylene Terephthlate	9	32	June 1962	
Polytetrafluoroethylene Plastics	8	31	June 1962	
Polytrychlorofluoro- ethylene Plastics	7	14	June 1962	
Aluminum Oxide				Compiled
Steatite				Compiled
Rubber Silicone				Compiled

IV. ANALYSIS OF REQUESTS

During the initial phases of the contract, requests were discouraged as much as possible with the feeling that they could not be handled adequately until a representative amount of material had been entered into the system. However, the Semiconductor and Insulator categories are now virtually complete as far as documentation is concerned and it is felt that questions can be adequately answered in these two areas.

Some requests have been answered. Most of these requests have been of a single-point retrieval type. That is, the requester was interested in only one document or one item of information which could be easily located through the index and either the document or the information was given to him. However, other requests have required extensive effort to complete. These requests have centered about exhaustive searches in specific materials or properties with the compilation of a bibliography to submit to the requester. These requests and their answers have been carefully analyzed in order to obtain a measure of our indexing system efficiency. Although it has become obvious that errors have crept into the system, such as transposition of accession numbers and mis-posting, in general, the system has performed well, enabling us to readily find the information sought by the requester.

From March to December of 1962, 12 extensive answers were given in reply to requests. It might be appropriate to mention four of these as being representative. These four were requests from the Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio, Aeronutronics, Republic Aviation, and Hughes Aircraft Company. The first request was from R. F. Klinger (ASRCM-1) and asked for specific information on the thermal properties of Beryllium Oxide. Two hours were spent in preparing literature references as well as specific data from these literature references by two of our subject specialists. The second request was in the form of a personal visit to the Center by a visitor from Aeronutronics. He was given complete access to the Center files on Semiconductors and he took notes and references for eight hours. After collecting his notes and references, he commented upon the excellent value of the Center files in the field and the usefulness of these notes and references to his work at Aeronutronics.

The third request was for information on the effects of ultra-high frequency on metallic and non-metallic materials (Plastics and Ceramics). Of particular interest was the effect in the mega-megacycle or teracycle range (10^{12}). Here again, a subject specialist was needed to compile the bibliography and to prepare information and data found in the collection.

The fourth request, the one from Hughes Aircraft, can be thoroughly evaluated. The Malibu Research Laboratories asked us to supply them with reprints of everything pertaining to the electronic properties of eight Semiconductor materials. These materials, with the number of properties of each are as follows: Cadmium Oxide (5), Cadmium Selenide (22), Cadmium Sulfide (25), Cadmium Telluride (24), Zinc Oxide (21), Zinc Selenide (16), Zinc Sulfide (24), Zinc Telluride (17). In total, 558 abstracts were involved, of which 452 were copied and sent to the Malibu Research Laboratories. These abstracts represented 1471 pages. Although this effort was charged directly to the Research Laboratories, it gave us a reading of the user viewpoint of our abstracting and the system, since Malibu agreed to give us their comments as to the adequacy of our work and to submit suggestions for its improvement. The total time required was 30 man hours of clerical work. The result shows that future estimates could be based upon about 50 pages per hour or 15 abstracts copied per hour. The number of abstracts for each material is known for over 200 materials and future estimates are likely to be fairly accurate. Since many of the abstracts cover two or more properties or materials, a check of the list obviated the making of duplicates, 105 in this case.

One qualifying factor applies in this situation and was accepted by Malibu. Our search on these particular materials was not considered fully complete in that we did not cross-check all the references given in each article to determine if we had overlooked any significant article or sources. These are being added as we complete the searches, our normal procedure to insure proper coverage of the literature.

The scientists at our research laboratories were very pleased with the search and the bibliography. They could offer very little in the way of suggestions for improvement of our system but on the contrary, were highly complimentary about our capability of providing them with information in the field of Semiconductors. It is interesting to note that very little technical effort was required to furnish the Research Laboratories with the information which they requested, but rather the hours of labor represented were clerical. This indicates the ease of use of our indexing system in obtaining this type of material.

In analyzing these representative requests, it becomes apparent that simple use of the system can be easily accomplished by the non-specialist, i. e., a librarian or even a clerk. However, the usefulness of a subject specialist in answering the more complex request cannot be minimized. No indexing system, regardless of how well conceived, can possibly cover all facets of the subject areas in every way they will be asked for. This fact will often mean that an interpolative function must take place that can be provided only by a person highly conversant with the subject.

One of the interesting aspects of the requests which have been received is the number of requests received from individuals engaged in research, an indication of the usefulness of this program to research as well as to applications. An example of a request of this nature was the request made by Mr. Jack Fraser, of the Santa Barbara Research Center of Hughes Aircraft Company. His request concerned information on materials data on infrared and semiconductor materials. Another item of interest has been the two requests for information on the use of Organic Semiconductors. Although a thesaurus was compiled on Organic Semiconductor materials, it was not expected that requests for information in this area would be very sudden or numerous. However, since the list of Organic Semiconductor materials was published in the last quarterly report, two requests have been received for information in this area. These two requests have come from Dr. C. A. Escoffery, of the Research and Development Division of the Aerospace Group, Hughes Aircraft Company and from Dr. Gary Carlson, of the Advanced Information Systems Company. In both instances, they were impressed with the work that we were doing in this field and encouraged us to continue on in Organic Semiconductors. It is anticipated that documentation will continue in Organic Semiconductors; however, it is felt that due to the urgent need for information in other areas, documentation will proceed only slowly.

V. OPERATIONS SUMMARY

In the six months some 16,000 titles and abstracts were searched with 3000 acquired. Of this number nearly 2200 were abstracted and indexed. Besides these, some 300 papers were indexed from work on hand at the start of the contract period. A similar situation exists for work on hand at present (185 items ready for coding). Retrospective documentation of the Semiconductor and Insulator categories was carried into the 1940 literature which of course extended the searches into the years before. About fifteen of the most productive journals are now being searched on a current basis. Papers from these are worked into the system. Some 600 papers in the new categories are printed, prepared and ready for abstracters.

As intended a considerable percentage of the abstracters' time during the subject period has been devoted to preparation for the coming year. Seven new categories of material had to be divided and assigned for detailed study in matters such as preparation of lists of materials, selection of properties lists and acquiring some background in the less familiar sections. Abstracters cover sheets have been prepared for Ferrites, Ferroelectrics, Ferromagnetics, Electroluminescents, Thermionic Emitters, Metals and Superconductors. No single author or source offered such analysis, and arrival at the properties selected represented much discussion with specialists in each field as well as practical decisions from our own staff.

VI. LISTS OF PROPERTIES

Since the beginning of the program, we have been faced with the problem of compiling properties in a consistent and organized fashion and yet categorizing electrical and electronic properties according to the main categories of materials (Semiconductors, Insulators, etc.). Some thought has even been given to eliminating the categories because the literature and the data therefrom does not always fit any preconceived plan of arrangement. Although categories can be useful, they can also present many problems. For example, how can the categories be defined? It's difficult to define them in terms of materials for many materials are useful in more than one category. In fact, some materials are known to change their characteristics so radically under certain conditions that they change categories.

It's even more difficult to define categories in terms of properties. Many properties appear in several categories with no change in meaning. Electrical resistivity and electrical conductivity are in a sense synonymous, representing only a matter of degree rather than individual properties.

These considerations have led us to consider both a consolidated properties list and a consolidated materials list. The latter is still under consideration.

In consideration of a consolidated properties list the group members have weighted values both ways. Eighteen months of experience with thousands of articles has provided subject specialists with bias, mostly towards making the routines as simple and exact as possible. In this light, use of a consolidated properties list, introduces a long learning period and hence reduces initial output from the specialist. This is because he must be able to recognize and estimate the worth of any one of 95 to 100 properties in the articles he surveys. Few persons are willing or able to be so broad. Preference is towards taking one material category and learning it well enough to evaluate data within boundaries agreed upon in the contract assignment. We have found this to be true even among scientists actively engaged in the field of their specialty. As abstracters and evaluators they tend to select among papers following their own local interests.

However, the case for a consolidated properties list is towards a more comprehensive coverage of what is found in an article. Authors do not confine themselves to any preconceived path of showing their experimental work. Often they find unexpected or compromised data which is nonetheless valuable or contributing to the sum of knowledge and so included. Often their work shades in and out of adjoining sciences, as from Chemistry to Physics, or from Metallurgy to Medicine.

On the other hand, there is a great need to retain the categories. Some users may want to retrieve all information on a single property or material but the average user will want only that portion of the literature or data dealing with the category he is interested in.

In view of offering better coverage of the literature and data in a more consistent fashion, the final decision has been to work from a single consolidated list of properties and to depend upon the inherent flexibility of the indexing system coupled with the IBM 1401 program to provide a categorization as useful to the user of the system. A complete evaluation of ways to do this is under study. As a first phase, a consolidated properties list follows. Following the list is a breakdown of the categories in which each individual property is useful.

INTERIM PROPERTIES LIST

Absolute Dielectric Constant

See DIELECTRIC CONSTANT

ABSORPTION

Absorption Coefficient

Absorption Edge

Absorption Spectrum

Infrared Absorption

Optical Absorption

Spectral Absorption

Absorption Coefficient

See ABSORPTION

Absorption Edge

See ABSORPTION

Absorption Spectrum

See ABSORPTION

Acoustoelectric Effect

See ELECTROACOUSTIC PROPERTIES

Acoustomagnetolectric Effect

See ELECTROACOUSTIC PROPERTIES

Activation Energy

See ENERGY GAP

Absorption

See SURFACE PROPERTIES

Alpha Irradiation

See IRRADIATION EFFECTS

Anisotropy Constants

See ELECTROMECHANICAL EFFECTS
MAGNETOMECHANICAL EFFECTS

ARC RESISTANCE

Tracking

Band Gap

See ENERGY GAP

Band Structure

See ENERGY BANDS

Barkhausen Effect
See **MAGNETIC HYSTERESIS LOOP CHARACTERISTICS**

Beta Irradiation
See **IRRADIATION EFFECTS**

Breakdown Voltage
See **DIELECTRIC STRENGTH**

CARRIER DIFFUSION
 Diffusion Coefficient
 Diffusion Length

Characteristic Length
See **DOMAIN STRUCTURE**

Coercive Field (Electrical)
See **ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS**

Coercive Field (Magnetic)
See **MAGNETIC HYSTERESIS LOOP CHARACTERISTICS**

Color Centers (F-Centers)
See **ENERGY LEVELS**

Collision Cross Sections
See **CROSS SECTIONS**

Complex Dielectric Constant
See **DIELECTRIC CONSTANT**

Conductivity
See **ELECTRICAL CONDUCTIVITY**
THERMAL CONDUCTIVITY

Contact Potential
See **SURFACE PROPERTIES**

Corbino Effect
See **MAGNETOELECTRIC PROPERTIES**

Corona Discharge
See **CORONA EFFECTS**

CORONA EFFECTS
 Corona Discharge
 Corona Point Voltage
 Corona Resistance

Corona Point Voltage
See **CORONA EFFECTS**

Corona Resistance

See CORONA EFFECTS

Cotangent θ

See DISSIPATION FACTOR

Critical Electric Field

See ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS

Critical Frequency

See PENETRATION DEPTH

Critical Magnetic Field

See MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Critical Magnetic Field, Superconductive

See THRESHOLD FIELD

Critical Temperature

See SUPERCONDUCTIVE TRANSITION TEMPERATURE

CROSS SECTIONS

Collision Cross Sections

Equivalent Cross Sections

Impurity Cross Sections

Recombination Cross Sections

Scattering Cross Sections

Mean Free Path

CURIE CONSTANT

Curie Point

See CURIE TEMPERATURE

CURIE TEMPERATURE

Curie Point

Cyclotron Resonance

See EFFECTIVE MASS

DEBYE TEMPERATURE

Decay Time

See LIFETIME

De Haas - Van Alphen Effect

See MAGNETIC SUSCEPTIBILITY

Dember Effect

See MOBILITY

Diamagnetic Susceptibility
See MAGNETIC SUSCEPTIBILITY

DIELECTRIC ABSORPTION

Dielectric Breakdown Voltage
See DIELECTRIC STRENGTH

DIELECTRIC CONSTANT

Absolute Dielectric Constant
Complex Dielectric Constant
Dielectric Relaxation Time
Electric Susceptibility
Polarization
Relative Dielectric Constant
Relative Capacitance
Specific Inductive Capacity (S. I. C.)
Permittivity

Dielectric Loss Angle
See DISSIPATION FACTOR

Dielectric Loss Factor
See LOSS FACTOR

Dielectric Loss Tangent
See DISSIPATION FACTOR

Dielectric Relaxation Time
See DIELECTRIC CONSTANT

DIELECTRIC STRENGTH

Breakdown Voltage
Dielectric Breakdown Voltage
Electrical Strength
Voltage Breakdown

Differential Susceptibility
See ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS

Diffusion Coefficient
See CARRIER DIFFUSION

Diffusion Length
See CARRIER DIFFUSION

DISSIPATION FACTOR

- Contangent θ
- Dielectric Loss Angle
- Dielectric Loss Tangent
- Loss Angle
- Loss Tangent
- Phase Angle
- Phase Defect Angle
- Quality Factor
- Storage Factor
- Tangent δ

Domain Boundary Growth Rate
See DOMAIN STRUCTURE

DOMAIN STRUCTURE

- Characteristic Length
- Domain Boundary Growth Rate
- Domain Wall Energy
- Domain Wall Mobility
- Domain Wall Thickness

Domain Wall Thickness
See DOMAIN STRUCTURE

Domain Wall Energy
See DOMAIN STRUCTURE

Domain Wall Mobility
See DOMAIN STRUCTURE

Drift Mobility
See MOBILITY

Drift Velocity
See MOBILITY

EFFECTIVE MASS

- Cyclotron Resonance
- Minority Carrier Effective Mass

Effective Permeability
See THRESHOLD FIELD

Electric Strength
See DIELECTRIC STRENGTH

Electric Susceptibility
See DIELECTRIC CONSTANT

Electric Anisotropy Constants
See ELECTROMECHANICAL EFFECTS

ELECTRICAL CONDUCTIVITY

Conductivity
Intrinsic Conductivity

ELECTRIC HYSTERESIS LOOP CHARACTERISTICS

Coercive Field, Electrical
Critical Electric Field
Differential Susceptibility
Initial Electrical Susceptibility
Maximum Coercive Field
Maximum Spontaneous Polarization
Output Voltage on Switching
Peaking Voltage
Peaking Time
Polarization Curves
Remanence Polarization
Small Signal Susceptibility
Switching Characteristics
Switching Time
Switching Voltage

Electric (al) Resistance

See INSULATION RESISTANCE

ELECTRICAL RESISTIVITY

Extrinsic Resistivity
Intrinsic Resistivity
Residual Electrical Resistivity
Resistivity (Electrical)
Specific Resistivity
Surface Resistance
Surface Resistivity
Te Value
Temperature Coefficient of Resistivity
Volume Resistivity

ELECTROACOUSTIC PROPERTIES

Acoustoelectric Effect
Acoustomagnetolectric Effect
Phonon Drag
Phonon Energy Levels

Electromechanical Coupling Coefficient

See PIEZOELECTRIC PROPERTIES

ELECTROMECHANICAL EFFECTS (Does not include electroacoustic

Anisotropy Constants effects)
Electrostriction

Electron Emission

See EMISSION

Electron Irradiation

See IRRADIATION EFFECTS

Electron Mobility
See MOBILITY

ELECTRONIC SPECIFIC HEAT
Heat Capacity

Electrostriction
See ELECTROMECHANICAL EFFECTS

EMISSION
Electron Emission
Field Emission
Ion Emission
Photoemission
Recombination Emission
Secondary Emission

Emission Spectra
See PHOTOELECTRONIC PROPERTIES

ENERGY BANDS
Band Structure

ENERGY GAP
Activation Energy
Band Gap
Forbidden Band Width
Forbidden Energy Gap
Forbidden Zone

ENERGY LEVELS
Color Centers
Exciton Levels
F-Centers
Ionization Energy
Nuclear Magnetic Resonance
Traps
Zeeman Effect

Equivalent Cross Sections
See CROSS SECTIONS

Ettingshausen Effect
See MAGNETOELECTRIC PROPERTIES

Exciton Levels
See ENERGY LEVELS

Extrinsic Resistivity
See ELECTRICAL RESISTIVITY

F-Centers (Farben, i. e., "Color" Centers)
See ENERGY LEVELS

Faraday Rotation
See GYROMAGNETIC EFFECTS

Fatigue
See LUMINESCENT EFFICIENCY

Ferromagnetic Resonance Absorption
See GYROMAGNETIC EFFECTS

Field Effect
See SURFACE PROPERTIES

Field Effect Mobility
See MOBILITY

Field Emission
See EMISSION

Figure of Merit
See THERMOELECTRIC PROPERTIES

Fluorescence
See PHOTOELECTRONIC PROPERTIES

Forbidden Band Width
See ENERGY GAP

Forbidden Energy Gap
See ENERGY GAP

Forbidden Zone
See ENERGY GAP

Frequency Constant
See PIEZOELECTRIC PROPERTIES

Galvanomagnetic Properties
See MAGNETOELECTRIC PROPERTIES

Generation-Recombination Noise
See LIFETIME

GYROMAGNETIC EFFECTS
Faraday Rotation
Ferromagnetic Resonance Absorption
Gyromagnetic Ratio

Gyromagnetic Ratio
See GYROMAGNETIC EFFECTS

HALL COEFFICIENT

Hall Constant
Hall Effect
Hall Voltage

Hall Constant
See HALL COEFFICIENT

Hall Effect
See HALL COEFFICIENT

Hall Mobility
See MOBILITY

Hall Voltage
See HALL COEFFICIENT

Heat Capacity
See ELECTRONIC SPECIFIC HEAT

Hole Mobility
See MOBILITY

Hysteresis Loss
See MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Imaginary Dielectric Constant
See LOSS FACTOR

Impurity Cross Sections
See CROSS SECTIONS

Impurity Mobility
See MOBILITY

Infrared Absorption
See ABSORPTION

INITIAL DIELECTRIC COEFFICIENT

Initial Permeability
See MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Initial Electrical Susceptibility
See ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS

Intrinsic Mobility
See MOBILITY

Intrinsic Resistivity
See ELECTRICAL RESISTIVITY

Ion Emission
See EMISSION

Ionization Energy
See ENERGY LEVELS

INSULATION RESISTANCE
Electric(al) Resistance
Temperature Coefficient of Resistance

Intrinsic Conductivity
See ELECTRICAL CONDUCTIVITY

IRRADIATION EFFECTS (Does not incl. electromagnetic radiation)
Alpha Irradiation
Beta Irradiation
Electron Irradiation
Neutron Irradiation
Proton Irradiation
Radiation Effects

Kelvin Effect
See THERMOELECTRIC PROPERTIES

LIFETIME
Decay Time
Generation-Recombination Noise
Minority Carrier Lifetime
Recombination
Recombination Centers
Recombination Noise
Relaxation Time

Loss Angle
See DISSIPATION FACTOR

LOSS FACTOR
Dielectric Loss Factor
Imaginary Dielectric Constant

Loss Tangent
See DISSIPATION FACTOR

Luminescence
See PHOTOELECTRONIC PROPERTIES

LUMINESCENT EFFICIENCY

Fatigue
Quenching

Magnetic Anisotropy Constants

See **MAGNETOMECHANICAL EFFECTS**

MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Barkhausen Effect
Coercive Field (Magnetic)
Critical Magnetic Field
Hysteresis Loss
Initial Permeability
Magnetization Decay
Magnetizing Field for Optimum Squareness Ratio
Maximum Permeability
Optimum Squareness Ratio
Output Voltage on Switching
Peaking Time
Remanence to Maximum Flux Density Ratio
Remanent Flux Density
Saturation Density
Switching Characteristics
Switching Time

MAGNETIC SUSCEPTIBILITY

De Haas - Van Alphen Effect
Diamagnetic Susceptibility
Magnetization
Paramagnetic Susceptibility

Magnetization

See **MAGNETIC SUSCEPTIBILITY**

Magnetization Decay

See **MAGNETIC HYSTERESIS LOOP CHARACTERISTICS**

Magnetizing Force for Optimum Squareness Ratio

See **MAGNETIC HYSTERESIS LOOP CHARACTERISTICS**

Magnetoelastic Energy

See **MAGNETOMECHANICAL EFFECTS**

MAGNETOELECTRIC PROPERTIES

Corbino Effect
Ettingshausen Effect
Galvanomagnetic Properties
Magnetoresistance

MAGNETOELECTROLUMINESCENT PROPERTIES

MAGNETOMECHANICAL EFFECTS

- Anisotropy Constants**
- Magnetic Anisotropy Constants**
- Magnetoelastic Energy**
- Magnetostriction**

Magnetoresistance

See **MAGNETOELECTRIC PROPERTIES**

Magnetostriction

See **MAGNETOMECHANICAL EFFECTS**

Maximum Coercive Field

See **ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS**

Maximum Permeability

See **MAGNETIC HYSTERESIS LOOP CHARACTERISTICS**

Maximum Spontaneous Polarization

See **ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS**

Mean Free Path

See **CROSS SECTIONS**

Mean Free Time

See **MOBILITY**

Mechanical Q

See **PIEZOELECTRIC PROPERTIES**

Meissner (Ochsenfeld) Effect

See **PENETRATION DEPTH**

Minority Carrier Effective Mass

See **EFFECTIVE MASS**

Minority Carrier Lifetime

See **LIFETIME**

MOBILITY

- Dember Effect**
- Drift Mobility**
- Drift Velocity**
- Electron Mobility**
- Field Effect Mobility**
- Hall Mobility**
- Hole Mobility**
- Impurity Mobility**
- Intrinsic Mobility**
- Mean Free Time**
- Transport of Carriers**

Nernst Effect
See THERMOMAGNETIC PROPERTIES

Nernst-Ettingshausen Effect
See THERMOMAGNETIC PROPERTIES

Neutron Irradiation
See IRRADIATION EFFECTS

Nuclear Magnetic Resonance
See ENERGY LEVELS

Optical Absorption
See ABSORPTION

Optimum Squareness Ratio
See MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Output Voltage on Switching
See ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS
MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Parabolic Threshold Field Curves
See THRESHOLD FIELD

Paramagnetic Susceptibility
See MAGNETIC SUSCEPTIBILITY

Peaking Time
See ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS
MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Peltier Coefficient
See THERMOELECTRIC PROPERTIES

PENETRATION DEPTH
Critical Frequency
Meissner (Ochsenfeld) Effect
Skin Depth

Permittivity
See DIELECTRIC CONSTANT

Phase Angle
See DISSIPATION FACTOR

Phase Defect Angle
See DISSIPATION FACTOR

Phonon Drag
See ELECTROACOUSTIC PROPERTIES

Phonon Energy Levels

See ELECTROACOUSTIC PROPERTIES

Phosphorescence

See PHOTOELECTRONIC PROPERTIES

Photoconductivity

See PHOTOELECTRONIC PROPERTIES

PHOTOELECTROLUMINESCENT PROPERTIES

Photovoltaic Effect

Photoelectromagnetic Effect (P. E. M.)

See PHOTOELECTRONIC PROPERTIES

PHOTOELECTRONIC PROPERTIES

Emission Spectra

Fluorescence

Luminescence

Photoconductivity

Photoelectromagnetic Effect (PEM)

Photomagnetolectric Effect (PME)

Photoluminescence

Photon Emission

Phosphorescence

Photovoltaic Effect

Spectral Response

Photoemission

See EMISSION

Photoluminescence (No Field Applied)

See PHOTOELECTRONIC PROPERTIES

Photomagnetolectric Effect (P. M. E.)

See PHOTOELECTRONIC PROPERTIES

Photon Emission

See PHOTOELECTRONIC PROPERTIES

Photovoltaic Effect (No electrical field present)

See PHOTOELECTRONIC PROPERTIES

Photovoltaic Effect (Electrical field present)

See PHOTOELECTROLUMINESCENT PROPERTIES

Piezoelectric Constants

See PIEZOELECTRIC PROPERTIES

PIEZOELECTRIC PROPERTIES

Electromechanical Coupling Coefficient
Frequency Constant
Mechanical Q
Piezoelectric Constants
Piezoelectricity
Piezoresistance

Piezoelectricity

See **PIEZOELECTRIC PROPERTIES**

Piezoresistance

See **PIEZOELECTRIC PROPERTIES**

Poisoning

See **SURFACE PROPERTIES**

Polarization

See **DIELECTRIC CONSTANT**

Polarization Curves

See **ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS**

POWER FACTOR

Proton Irradiation

See **IRRADIATION EFFECTS**

Quality Factor

See **DISSIPATION FACTOR**

Quenching

See **LUMINESCENT EFFICIENCY**

Radiation Effects

See **IRRADIATION EFFECTS**

Recombination

See **LIFETIME**

Recombination Centers

See **LIFETIME**

Recombination Cross Sections

See **CROSS SECTIONS**

Recombination Emission

See **EMISSION**

Recombination Noise

See **LIFETIME**

Recombination Spectra

See **LIFETIME**

REFLECTION

Reflectivity

Reflection Coefficients

See **RICHARDSON'S CONSTANT**

Reflectivity

See **REFLECTION**

Refraction

See **REFRACTIVE INDEX**

REFRACTIVE INDEX

Refraction

Relative Capacitance

See **DIELECTRIC CONSTANT**

Relative Dielectric Constant

See **DIELECTRIC CONSTANT**

Relaxation Time

See **LIFETIME**

Remanence Polarization

See **ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS**

Remanence to Maximum Flux Density Ratio

See **MAGNETIC HYSTERESIS LOOP CHARACTERISTICS**

Remanent Flux Density

See **MAGNETIC HYSTERESIS LOOP CHARACTERISTICS**

Residual Electrical Resistivity

See **ELECTRICAL RESISTIVITY**

Resistivity

See **ELECTRICAL RESISTIVITY**

Resistivity (Thermal)

See **THERMAL CONDUCTIVITY**

RICHARDSON'S CONSTANT

Reflection Coefficients

Righi-Leduc Effect

See **THERMOMAGNETIC PROPERTIES**

Saturation Flux Density
See MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Saturation Susceptibility
See ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS

Scattering Cross Sections
See CROSS SECTIONS

Secondary Emission
See EMISSION

Seebeck Coefficient
See THERMOELECTRIC PROPERTIES

Seebeck Effect
See THERMOELECTRIC PROPERTIES

Seebeck Voltage
See THERMOELECTRIC PROPERTIES

Skin Depth
See PENETRATION DEPTH

Small Signal Susceptibility
See ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS

Specific Inductive Capacitance (S. I. C.)
See DIELECTRIC CONSTANT

Specific Resistivity
See ELECTRICAL RESISTIVITY

Specific Transition Temperature
See SUPERCONDUCTIVE TRANSITION TEMPERATURE

Spectral Absorption
See ABSORPTION

Spectral Response
See PHOTOELECTRONIC PROPERTIES

Storage Factor
See DISSIPATION FACTOR

Suhl Effect
See SURFACE PROPERTIES

Superconductive Critical Field
See THRESHOLD FIELD

Superconductive Temperature Interval
See **SUPERCONDUCTIVE TRANSITION TEMPERATURE**

SUPERCONDUCTIVE TRANSITION TEMPERATURE

Critical Temperature
Specific Transition Temperature
Transition Temperature

SURFACE PROPERTIES

Field Effect
Suhl Effect
Contact Potential

SURFACE PROPERTIES (THIN FILM CHARACTERISTICS)

Absorption
Poisoning

Surface Resistance

See **ELECTRICAL RESISTIVITY**

Surface Resistivity

See **ELECTRICAL RESISTIVITY**

Switching Characteristics

See **ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS**
MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Switching Time

See **ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS**
MAGNETIC HYSTERESIS LOOP CHARACTERISTICS

Switching Voltage

See **ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS**

Tangent δ

See **DISSIPATION FACTOR**

Te Value

See **ELECTRICAL RESISTIVITY**

Temperature Coefficient of Resistivity

See **ELECTRICAL RESISTIVITY**

THERMAL CONDUCTIVITY

Conductivity
Resistivity (Thermal)
Thermal Resistivity

THERMAL EFFICIENCY

Thermal Emission
See EMISSION

Thermal Resistivity
See THERMAL CONDUCTIVITY

Thermionic Emission
See EMISSION

Thermoelectric Figure of Merit
See THERMOELECTRIC PROPERTIES

Thermoelectric Power
See THERMOELECTRIC PROPERTIES

THERMOELECTRIC PROPERTIES

Figure of Merit
Kelvin Effect
Seebeck Coefficient
Peltier Coefficient
Seebeck Effect
Seebeck Voltage
Thermoelectric Figure of Merit
Thermoelectric Power
Thomson Coefficient

THERMOELECTROLUMINESCENT PROPERTIES

THERMOMAGNETIC PROPERTIES

Nernst Effect
Nernst-Ettingshausen Effect
Righi-Leduc Effect

Thomson Coefficient
See THERMOELECTRIC PROPERTIES

Tracking
See ARC RESISTANCE

THRESHOLD FIELD

Critical Field, Superconductive
Effective Permeability
Parabolic Threshold Curves
Superconductive Critical Field

Transition Temperature
See SUPERCONDUCTIVE TRANSITION TEMPERATURE

Transport of Carriers
See MOBILITY

Traps

See **ENERGY LEVELS**

Voltage Breakdown

See **DIELECTRIC STRENGTH**

Volume Resistivity

See **ELECTRICAL RESISTIVITY**

WORK FUNCTION

Zeeman Effect

See **ENERGY LEVELS**

CATEGORY - PROPERTY CROSS INDEX

	Superconductors	Ferromagnetics	Semiconductors	Insulators	Ferrites	Ferroelectrics	Metals	Electroluminescent Materials	Thermionic Emitters
ABSORPTION			X					X	
ARC RESISTANCE				X					
CARRIER DIFFUSION			X					X	
CORONA EFFECTS				X					
CROSS SECTIONS			X					X	X
CURIE CONSTANT		X			X				
CURIE TEMPERATURE		X			X	X			
DEBYE TEMPERATURE	X		X						
DIELECTRIC ABSORPTION				X	X	X			
DIELECTRIC CONSTANT			X	X	X	X		X	
DIELECTRIC STRENGTH				X		X		X	
DISSIPATION FACTOR				X	X	X			
DOMAIN STRUCTURE	X	X			X	X			
EFFECTIVE MASS			X						
ELECTRICAL CONDUCTIVITY			X	X			X	X	X
ELECTRICAL HYSTERESIS LOOP CHARACTERISTICS						X			
ELECTRICAL RESISTIVITY	X		X	X	X	X		X	X
ELECTROACOUSTIC PROPERTIES			X						
ELECTROMECHANICAL PROPERTIES						X			
ELECTRONIC SPECIFIC HEAT	X								
EMISSION			X					X	X
ENERGY BANDS			X					X	
ENERGY GAP	X		X					X	

CATEGORY - PROPERTY CROSS INDEX (Continued)

	Superconductors	Ferromagnetics	Semiconductors	Insulators	Ferrites	Ferroelectrics	Metals	Electroluminescent Materials	Thermionic Emitters
ENERGY LEVELS			X					X	
GYROMAGNETIC EFFECTS					X				
HALL COEFFICIENT			X						
INITIAL DIELECTRIC COEFFICIENT						X			
INSULATION RESISTANCE				X					
IRRADIATION EFFECTS	X	X	X	X	X	X	X	X	X
LIFETIME			X			X		X	X
LOSS FACTOR				X	X	X			
LUMINESCENT EFFICIENCY								X	
MAGNETIC HYSTERESIS LOOP CHARACTERISTICS		X			X				
MAGNETIC SUSCEPTIBILITY	X		X					X	
MAGNETOELECTRIC PROPERTIES			X		X				
MAGNETOELECTRO-LUMINESCENT PROPERTIES								X	
MAGNETOMECHANICAL EFFECTS		X			X				
MOBILITY			X			X		X	
PENETRATION DEPTH	X								
PHOTOELECTRO-LUMINESCENT PROPERTIES								X	
PHOTOELECTRONIC PROPERTIES			X					X	
PIEZOELECTRIC PROPERTIES			X			X		X	
POWER FACTOR				X					

CATEGORY - PROPERTY CROSS INDEX (Continued)

	Superconductors	Ferromagnetics	Semiconductors	Insulators	Ferrites	Ferroelectrics	Metals	Electroluminescent Materials	Thermionic Emitters
REFLECTION			X						
REFRACTIVE INDEX			X						
RICHARDSON'S CONSTANT									X
SUPERCONDUCTIVE TRANSITION TEMPERATURE	X								
SURFACE PROPERTIES			X					X	X
SURFACE PROPERTIES (THIN FILM CHARACTERISTICS)									X
THERMAL CONDUCTIVITY	X		X						X
THERMAL EFFICIENCY									X
THERMOELECTRIC PROPERTIES			X			X			
THERMOELECTRO-LUMINESCENT PROPERTIES								X	
THERMOMAGNETIC PROPERTIES	X	X	X		X				
THRESHOLD FIELD	X								
WORK FUNCTION			X					X	X

VII. LISTS OF MATERIALS

Included in this section of the report are lists of materials in the seven new categories of materials under study during the six-month extension to the contract. Accompanying the lists are brief discussions of the rationale behind the adoption of the terms as an indexing vocabulary to be used in indexing the literature. The lists are tentative and will be modified as required as the literature is indexed. Also included is the list of Organic Semiconductor materials which first appeared in the Fourth Quarterly Progress Report.

A. Electroluminescent Materials

A material is considered to be electroluminescent if it exhibits luminescence when placed in an electric field. For each of the materials listed, experimental electroluminescent data have been found. The sources which yielded these data and materials were generally review and summary articles, and as the pertinent literature in this category is searched and abstracted the list will undergo revision.

Data other than luminescence as a function of field strength or current density is being accepted; for example, quenching of luminescence, luminescence efficiency and energy levels (see the list of electroluminescent properties). This type of data is included because of its direct relation to electroluminescence and is accepted even if it is from other types of experiments, i. e., photoluminescence or thermoluminescence experiments. It must be understood however, that pure thermoluminescence or photoluminescence data is not being included in this category, and that these other data are accepted only if they are from experiments performed on materials which are known to be electroluminescent. This restriction placed upon the materials list is necessary to ensure that the electroluminescent category is not lost in the wealth of general luminescent information.

There has been no attempt to consider the luminescent activators in this materials list. Their importance will not be minimized in this category, and they will receive full consideration in the compilation and in additional work in this category, but they will not be considered in the authority list of electroluminescent materials.

The lower case descriptors in the Electroluminescent and the Thermionic Emitter lists are included as cross references. When they are listed alphabetically, an upper case See reference is given.

ELECTROLUMINESCENT MATERIALS

ACRIDINE

ACRIFLAVINE

- X - Euflavine
- Trypaflavine neutral
- Neutral acriflavine
- Gonacrin
- 2,8-diamino-10-methyl acridinium Chloride

ALUMINUM NITRIDE

ALUMINUM OXIDE

- X - Sapphire

ALUMINUM OXIDE-MAGNESIUM OXIDE SYSTEMS

- X - Magnesium Aluminate

ALUMINUM PHOSPHIDE

ARSENIC-GALLIUM-PHOSPHORUS SYSTEMS

BARIUM OXIDE-TITANIUM OXIDE SYSTEMS

- X - Barium Titanate

Barium Titanate

See BARIUM OXIDE-TITANIUM OXIDE SYSTEMS

BORON NITRIDE

CADMIUM-MANGANESE-SULFUR-ZINC SYSTEMS

- X - Zinc Sulfide-Cadmium Sulfide-Manganese Sulfide

CADMIUM OXIDE

CADMIUM SELENIDE

CADMIUM SULFIDE

CADMIUM-SULFUR-ZINC SYSTEMS

- X - Zinc-Cadmium Sulfide

CALCIUM OXIDE-TITANIUM OXIDE SYSTEMS

- X - Calcium Titanate

CALCIUM OXIDE-TUNGSTEN OXIDE SYSTEMS

- X - Calcium Tungstate

Calcium Titanate

See CALCIUM OXIDE-TITANIUM OXIDE SYSTEMS

Calcium Tungstate

See CALCIUM OXIDE-TUNGSTEN OXIDE SYSTEMS

CARBAZOLE

Incl

Dibenzopyrrole

Diphenylenimine

CARBON (DIAMOND)

CESIUM ANTIMONIDE

2,8-diamino-10-methyl acridinium chloride

See ACRIFLAVINE

Diamond

See CARBON (DIAMOND)

Dibenzopyrrole

See CARBAZOLE

Diphenylenimine

See CARBAZOLE

Euflavine

See ACRIFLAVINE

GALLIUM ANTIMONIDE

GALLIUM ARSENIDE

GALLIUM-INDIUM-PHOSPHORUS SYSTEMS

GALLIUM NITRIDE

GALLIUM PHOSPHIDE

GERMANIUM

Gonacrin

See ACRIFLAVINE

INDIUM PHOSPHIDE

LEAD OXIDE-ZIRCONIUM OXIDE SYSTEMS

X - Lead Zirconate

Lead Zirconate

See LEAD OXIDE-ZIRCONIUM OXIDE SYSTEMS

LITHIUM-SULFUR-ZINC SYSTEMS

X - Lithium Zinc Sulfide

Lithium Zinc Sulfide

See LITHIUM-SULFUR-ZINC SYSTEMS

Magnesium Aluminate

See ALUMINUM OXIDE-MAGNESIUM OXIDE SYSTEMS

MAGNESIUM OXIDE-ZINC OXIDE SYSTEMS

X - Magnesium-Zinc Oxide

Magnesium-Zinc Oxide

See MAGNESIUM OXIDE ZINC OXIDE SYSTEMS

MANGANESE OXIDE-SILICON OXIDE-ZINC OXIDE SYSTEM

X - Zinc Silicate - Manganese Silicate

Neutral Acriflavine

See ACRIFLAVINE

NIOBIUM OXIDE-POTASSIUM OXIDE SYSTEMS

X - Potassium Niobate

Potassium Niobate

See NIOBIUM OXIDE-POTASSIUM OXIDE SYSTEMS

POTASSIUM SULFATE-URANYL SULFATE SYSTEMS

Sapphire

See ALUMINUM OXIDE

SELENIUM-SULFUR-ZINC SYSTEMS

X - Zinc Selenium Sulfide

Scheelite

See CALCIUM OXIDE-TUNGSTEN OXIDE SYSTEMS

SILICON CARBIDE

SILICON OXIDE-ZINC OXIDE SYSTEMS

X - Zinc Silicate

Zinc Orthosilicate

Willemite

STRONTIUM OXIDE-TITANIUM OXIDE SYSTEMS

X - Strontium Titanate

STRONTIUM SULFIDE

Strontium Titanate

See STRONTIUM OXIDE-TITANIUM OXIDE SYSTEMS

TITANIUM OXIDE

Trypaflavine, Neutral

See ACRIFLAVINE

Willemite

See SILICON OXIDE ZINC OXIDE SYSTEMS

Zinc-Cadmium Sulfide

See CADMIUM-SULFUR-ZINC SYSTEMS

ZINC FLUORIDE

Zinc Orthosilicate

See SILICON OXIDE-ZINC OXIDE SYSTEMS

ZINC SELENIDE

Zinc Selenium Sulfide

See SELENIUM-SULFUR-ZINC SYSTEMS

Zinc Silicate

See SILICON OXIDE ZINC OXIDE SYSTEMS

Zinc Silicate-Manganese Silicate

**See MANGANESE OXIDE SILICON OXIDE ZINC OXIDE
SYSTEMS**

ZINC SULFIDE

Zinc Sulfide Cadmium Sulfide Manganese Sulfide

See CADMIUM MANGANESE SULFUR ZINC SYSTEMS

B. Thermionic Emitter Material

A material is considered a Thermionic Emitter if it emits electrons under increased temperatures. The procedure followed for this materials list was the same as in the Electroluminescent category. A material must first exhibit thermionic emission; that is the primary consideration. Other data such as thermal efficiency and poisoning are accepted even when they are obtained from experiments in field emission, photoemission, or secondary emission. These experiments must, however, be performed on materials which are known Thermionic Emitters, before the data is included. The sources were summary and review articles on thermionic emission, but in most cases it was necessary to return to the original article. This is not to say that the Electroluminescent materials were not studied carefully, but rather that the materials and experiments which yield thermionic emission data required more delineation than do the Electroluminescent materials and experiments.

The descriptors referred to as oxygen systems in this list do not refer to oxides. Rather, they refer to solid solutions of oxygen and the base material. There is little uniformity in the preparation of the cathodes used in thermionic emission experiments. (Thermionic emission experiments on cathodes are not considered device-oriented.) One such method of preparation is the oxygen coated cathode. This type cathode is prepared by the adsorption of oxygen onto the surface of the base material. This does not yield an oxide, but rather the solid solution which has been called the oxygen system. The only attempt to differentiate between film and bulk effect in this list of materials is in the lower case references. An example of this is Zirconium-Barium Oxide where zirconium is the base material and barium oxide is the emitting surface. Data on this cathode is indexed under BARIUM OXIDE and will be differentiated from bulk barium oxide in the evaluation and data sheet preparation.

THERMIONIC EMITTER MATERIALS

ALUMINUM

ANTIMONY

ARSENIC

BARIUM

X-Tungsten-Barium
Strontium-Barium

BARIUM BORIDE

BARIUM OXIDE

X-Zirconium-Barium Oxide
Tungsten-Barium Oxide
Tantalum-Barium Oxide
Platinum-Iridium-Barium Oxide
Platinum-Barium Oxide
Nickel-Barium Oxide
Molybdenum-Barium Oxide

BARIUM OXIDE-STRONTIUM OXIDE
SYSTEMS

BARIUM OXIDE-STRONTIUM OXIDE-
CALCIUM OXIDE SYSTEMS

BARIUM-OXYGEN-TUNGSTEN SYSTEMS

BARIUM SULFIDE

X-Platinum-Barium Sulfide
Niobium-Barium Sulfide

BERYLLIUM

BISMUTH

BORON

BORON NITRIDE

CADMIUM

CALCIUM

CALCIUM BORIDE

CALCIUM OXIDE

X-Tungsten - Calcium Oxide

CARBON

CERIUM

X-Tungsten-Cerium

CERIUM BORIDE

CESIUM

CESIUM OXYGEN TUNGSTEN SYSTEMS

CHROMIUM

COBALT

COPPER

GADOLINIUM OXIDE-TERBIUM OXIDE SYSTEMS

GALLIUM

GERMANIUM

GOLD

GOLD-OXYGEN SYSTEM

HAFNIUM

HAFNIUM-OXYGEN SYSTEM

IRIDIUM

Iridium - Thorium Oxide

See THORIUM OXIDE

IRON

LANTHANUM

X-Tungsten-Lanthanum

LANTHANUM BORIDE

LEAD

LEAD OXIDE

LITHIUM

MAGNESIUM

MANGANESE

MERCURY

MISCHMETAL

MOLYBDENUM

Molybdenum-Barium Oxide
See BARIUM OXIDE

Molybdenum-Calcium Oxide
See CALCIUM OXIDE

Molybdenum-Strontium Oxide
See STRONTIUM OXIDE

Molybdenum-Thorium
See THORIUM

NEODYMIUM

NEODYMIUM OXIDE-LANTHANUM OXIDE SYSTEMS

NICKEL

Nickel-Barium Oxide
See BARIUM OXIDE

Nickel-Strontium Oxide
See STRONTIUM OXIDE

NIOBIUM (COLUMBIUM)

Niobium-Barium Sulfide
See BARIUM SULFIDE

NIOBIUM BORIDE

NIOBIUM-OXYGEN SYSTEM

OSMIUM

OXYGEN-PLATINUM SYSTEMS

OXYGEN-TUNGSTEN SYSTEMS

OXYGEN-ZIRCONIUM SYSTEMS

PALLADIUM

PLATINUM

Platinum-Barium Oxide
See BARIUM OXIDE

Platinum-Barium Sulfide
See BARIUM SULFIDE

Platinum-Iridium-Barium Oxide
See BARIUM OXIDE

Platinum-Iridium-Strontium Oxide
See STRONTIUM OXIDE

Platinum-Strontium Oxide
See STRONTIUM OXIDE

POTASSIUM

PRASEODYMIUM

PRASEODYMIUM BORIDE

PROTACTINIUM

PROTACTINIUM BORIDE

RUBIDIUM

RUBIDIUM OXIDE-TUNGSTEN OXIDE SYSTEMS
X-RUBIDIUM TUNGSTATE

RUBIDIUM TUNGSTATE
See RUBIDIUM OXIDE-TUNGSTEN OXIDE SYSTEMS

SAMARIUM

SELENIUM

SILICON

SILVER

SODIUM

STRONTIUM

Strontium Barium
See BARIUM

STRONTIUM OXIDE

X-Tungsten-Strontium Oxide
Tantalum-Strontium Oxide
Platinum-Strontium Oxide
Platinum-Iridium-Strontium Oxide
Nickel-Strontium Oxide
Molybdenum-Strontium Oxide

TANTALUM

Tantalum-Barium Oxide
See BARIUM OXIDE

TANTALUM BORIDE

TANTALUM CARBIDE

TANTALUM NITRIDE

Tantalum-Strontium Oxide
See STRONTIUM OXIDE

Tantalum-Thorium
See THORIUM

TELLURIUM

THALLIUM

THORIUM

X-Tungsten-Thorium
Tantalum-Thorium
Molybdenum-Thorium

THORIUM BORIDE

THORIUM CARBIDE

THORIUM OXIDE

X-Iridium-Thorium Oxide
Tungsten-Thorium Oxide

THORIUM SULFIDE

X-Tungsten-Thorium Sulfide

TIN

TITANIUM

TITANIUM CARBIDE

TITANIUM NITRIDE

**TITANIUM OXIDE-ZIRCONIUM OXIDE
SYSTEMS**

X-Zirconium

TUNGSTEN

Tungsten-Barium
See BARIUM

Tungsten-Barium Oxide
See BARIUM OXIDE

Tungsten-Calcium Oxide
See CALCIUM OXIDE

Tungsten-Cerium
See CERIUM

Tungsten-Lanthanum
See LANTHANUM

Tungsten-Strontium Oxide
See STRONTIUM OXIDE

Tungsten-Thorium
See THORIUM

Tungsten-Thorium Oxide
See THORIUM OXIDE

Tungsten-Thorium Sulfide
See THORIUM SULFIDE

Tungsten-Uranium
See URANIUM

Tungsten-Yttrium
See YTTRIUM

Tungsten-Zirconium
See ZIRCONIUM

URANIUM
X-Tungsten-Uranium

VANADIUM

YTTRIUM
X-Tungsten-Yttrium

ZINC

ZIRCONIUM

X-Tungsten-Zirconium

Zirconium-Barium Oxide

See BARIUM OXIDE

ZIRCONIUM BORIDE

ZIRCONIUM CARBIDE

ZIRCONIUM NITRIDE

ZIRCONIUM OXIDE

Zirconium Titanate

See TITANIUM OXIDE-ZIRCONIUM OXIDE SYSTEMS

C. Ferroelectric, Ferrite, Ferromagnetic and Superconductor Materials

The following lists of materials include Ferroelectric, Ferrites, Ferromagnetic, and Superconductors. They include no cross references. Each of the lists has been compiled from various secondary literature sources such as texts, summary reports or monographs. Although secondary sources were used a cursory check of the original sources was performed.

The naming systems in both the secondary and primary sources followed no uniformity, for example CNb_2 was listed as a superconductor in B. W. Roberts' report "Superconducting Materials and some of their properties". The original source of this information, [Hardy, G. F. and Hulm, J. K., Phys. Rev. 93, 1004 (1954)] cites the material as Nb_2C . Most of the superconductors in our list have been called systems. This denotes that they are either solid solutions or nonstoichiometric crystals which have been distorted from their original lattice structure. As the original sources are checked for each of these materials they will be named systems or compounds (such as Niobium Carbide in the above case) depending upon the original data.

Most of the materials in the Ferrite list are in reality the type of crystalline structure described above and are called oxide systems. Some ferrites however are stoichiometric compounds with undistorted crystalline structure. An example of this is Iron Oxide, but by and large these materials will use the oxide systems notation. The Ferromagnetic materials are recognized as alloys and because of their solid solution type structure they have also been named systems, so as to conform with our naming system. The Oxide compound system names have again been used.

The ferroelectric list of materials is the most conglomerate in types of names. The organic materials names have been used as they were found in the literature. Where possible the non-organic materials names have been changed to conform to our naming system. An example of this is the changing of Lead Bismuth Niobate to Bismuth Oxide-Lead Oxide-Niobium Oxide Systems, with a cross reference. In some non-organic materials where the generic name is in wide usage and is recognized as a Ferroelectric then it has been retained. Ammonium Alum is an example of this procedure. None of these Ferroelectric materials names contain any of the hydration notation and there has been no attempt to differentiate between the presence of hydrogen and deuterium.

FERROELECTRIC MATERIALS

AMMONIUM BISULFATE

2-AMMONIUM 2-CADMIUM SULFATE

AMMONIUM FLUOBERYLLATE

AMMONIUM INDIUM ALUM

AMMONIUM IRON ALUM

AMMONIUM MONOCHLOROACETATE

AMMONIUM SULFATE

AMMONIUM VANADIUM ALUM

BARIUM LITHIUM OXYFLUOALUMINATE

BARIUM OXIDE BISMUTH OXIDE TITANIUM OXIDE SYSTEMS

BARIUM OXIDE CALCIUM OXIDE TITANIUM OXIDE SYSTEMS

BARIUM OXIDE MAGNESIUM OXIDE TITANIUM OXIDE SYSTEMS

BARIUM OXIDE STRONTIUM OXIDE TITANIUM OXIDE SYSTEMS

BARIUM OXIDE TANTALUM OXIDE SYSTEMS

BARIUM OXIDE TIN OXIDE TITANIUM OXIDE SYSTEMS

BARIUM OXIDE TITANIUM OXIDE SYSTEMS

BARIUM OXIDE ZIRCONIUM OXIDE SYSTEMS

BISMUTH OXIDE LEAD OXIDE NIOBIUM OXIDE SYSTEMS

BISMUTH OXIDE STRONTIUM OXIDE TITANIUM OXIDE SYSTEMS

BISMUTH OXIDE TITANIUM OXIDE SYSTEMS

CADMIUM OXIDE NIOBIUM OXIDE SYSTEMS

CADMIUM OXIDE TITANIUM OXIDE SYSTEMS

CALCIUM OXIDE BARIUM OXIDE SYSTEMS

CALCIUM OXIDE MAGNESIUM OXIDE TITANIUM OXIDE SYSTEMS

CALCIUM OXIDE NIOBIUM OXIDE SYSTEMS
CALCIUM OXIDE TANTALUM OXIDE SYSTEMS
CALCIUM OXIDE TITANIUM OXIDE SYSTEMS
CALCIUM OXIDE ZIRCONIUM OXIDE SYSTEMS
2-CALCIUM STRONTIUM PROPIONATE
CESIUM HYDROGEN ARSENATES
CESIUM HYDROGEN PHOSPHATE
3-GLYCINE FLUOBERYLLATE
2-GLYCINE MANGANOUS CHLORIDE
2-GLYCINE NITRATE
3-GLYCINE SELENATE
GLYCINE SILVER NITRATE
3-GLYCINE SULFATE
GUANIDINE ALUMINUM SELENATE
GUANIDINE ALUMINUM SULFATES
GUANIDINE CHROMIUM SELENATE
GUANIDINE CHROMIUM SULFATE
GUANIDINE GALLIUM SELENATE
GUANIDINE GALLIUM SULFATE
GUANIDINE VANADIUM SULFATE
IRON OXIDE LEAD OXIDE NIOBIUM OXIDE SYSTEMS
LANTHANUM OXIDE TITANIUM OXIDE SYSTEMS
LEAD OXIDE MAGNESIUM OXIDE NIOBIUM OXIDE SYSTEMS
LEAD OXIDE NIOBIUM OXIDE SYSTEMS
LEAD OXIDE TANTALUM OXIDE SYSTEMS
LEAD OXIDE TITANIUM OXIDE SYSTEMS

LEAD OXIDE ZIRCONIUM OXIDE SYSTEMS
LITHIUM AMMONIUM TARTRATE
LITHIUM HYDRAZINUM SULFATE
LITHIUM HYDROGEN SELENITE
LITHIUM OXIDE NIOBIUM OXIDE SYSTEMS
LITHIUM OXIDE TANTALUM OXIDE SYSTEMS
LITHIUM THALLIUM TARTRATE
MAGNESIUM OXIDE NIOBIUM OXIDE SYSTEMS
MAGNESIUM OXIDE TANTALUM OXIDE SYSTEMS
MAGNESIUM OXIDE TITANIUM OXIDE SYSTEMS
MAGNESIUM OXIDE ZIRCONIUM OXIDE SYSTEMS
METHYLAMMONIUM ALUMINUM ALUMS
METHYLAMMONIUM ALUMINIUM SELENATE
METHYLAMMONIUM CHROME ALUM
METHYLAMMONIUM GALLIUM ALUM
METHYLAMMONIUM INDIUM ALUM
METHYLAMMONIUM IRON ALUM
METHYLAMMONIUM VANADIUM ALUM
NIOBIUM OXIDE POTASSIUM OXIDE SYSTEMS
NIOBIUM OXIDE SODIUM OXIDE SYSTEMS
NIOBIUM OXIDE ZINC OXIDE SYSTEMS
NIOBIUM OXIDE ZIRCONIUM OXIDE SYSTEMS
POTASSIUM FERROCYANIDE
POTASSIUM HYDROGEN ARSENATES
POTASSIUM HYDROGEN PHOSPHATES
POTASSIUM NITRATE

POTASSIUM OXIDE SODIUM OXIDE TANTALUM OXIDE SYSTEMS

POTASSIUM OXIDE TANTALUM OXIDE SYSTEMS

POTASSIUM OXIDE TITANIUM OXIDE SYSTEMS

POTASSIUM TARTRATE

RUBIDIUM BISULFATE

RUBIDIUM HYDROGEN ARSENATES

RUBIDIUM HYDROGEN PHOSPHATES

RUBIDIUM SODIUM TARTRATE

SILICON OXIDE TITANIUM OXIDE SYSTEMS

SODIUM AMMONIUM TARTRATE

SODIUM HYDROGEN SELENITE

SODIUM NITRITE

SODIUM OXIDE TANTALUM OXIDE SYSTEMS

SODIUM OXIDE VANADIUM OXIDE SYSTEMS

SODIUM POTASSIUM TARTRATES

STRONTIUM OXIDE NIOBIUM OXIDE SYSTEMS

STRONTIUM OXIDE TANTALUM OXIDE SYSTEMS

STRONTIUM OXIDE TITANIUM OXIDE SYSTEMS

STRONTIUM OXIDE ZIRCONIUM OXIDE SYSTEMS

TANTALUM OXIDE ZINC OXIDE SYSTEMS

TITANIUM OXIDE ZIRCONIUM OXIDE SYSTEMS

TETRAMETHYLAMMONIUM 3-CHLOROMERCURIATE

THIOUREA

TUNGSTEN OXIDE

UREA CHROME ALUM

FERRITE MATERIALS

ALUMINUM OXIDE IRON OXIDE NICKEL OXIDE SYSTEMS

ALUMINUM OXIDE MAGNESIUM OXIDE SYSTEMS

ALUMINUM OXIDE NICKEL OXIDE SYSTEMS

BARIUM OXIDE COBALT OXIDE IRON OXIDE SYSTEMS

BARIUM OXIDE IRON OXIDE SYSTEMS

BARIUM OXIDE IRON OXIDE MAGNESIUM OXIDE SYSTEMS

BARIUM OXIDE IRON OXIDE MANGANESE OXIDE SYSTEMS

BARIUM OXIDE IRON OXIDE NICKEL OXIDE SYSTEMS

BARIUM OXIDE IRON OXIDE ZINC OXIDE SYSTEMS

BARIUM OXIDE LANTHANUM OXIDE MANGANESE OXIDE
STRONTIUM OXIDE SYSTEMS

CADMIUM OXIDE IRON OXIDE SYSTEMS

CADMIUM OXIDE LANTHANUM OXIDE MANGANESE OXIDE
SYSTEMS

CALCIUM OXIDE LANTHANUM OXIDE MANGANESE OXIDE
SYSTEMS

CHROMIUM OXIDE IRON OXIDE SYSTEMS

CHROMIUM OXIDE IRON OXIDE LITHIUM OXIDE SYSTEMS

CHROMIUM OXIDE IRON OXIDE MAGNESIUM OXIDE SYSTEMS

CHROMIUM OXIDE MAGNESIUM OXIDE SYSTEMS

CHROMIUM OXIDE NICKEL OXIDE SYSTEMS

COBALT OXIDE IRON OXIDE SYSTEMS

COBALT OXIDE IRON OXIDE MANGANESE OXIDE SYSTEMS

COBALT IRON OXIDE MANGANESE OXIDE NICKEL OXIDE SYSTEMS

COBALT OXIDE IRON OXIDE NICKEL OXIDE SYSTEMS

COBALT OXIDE IRON OXIDE ZINC OXIDE SYSTEMS

COBALT OXIDE MANGANESE OXIDE SYSTEMS
COPPER OXIDE IRON OXIDE SYSTEMS
COPPER OXIDE IRON OXIDE ZINC OXIDE SYSTEMS
DYSPROSIUM OXIDE IRON OXIDE SYSTEMS
EUROPIUM OXIDE IRON OXIDE SYSTEMS
GADOLINIUM OXIDE IRON OXIDE SYSTEMS
HOLMIUM OXIDE IRON OXIDE SYSTEMS
IRON OXIDE
IRON OXIDE LITHIUM OXIDE ZINC OXIDE SYSTEMS
IRON OXIDE LUTETIUM OXIDE SYSTEMS
IRON OXIDE MAGNESIUM OXIDE SYSTEMS
IRON OXIDE MAGNESIUM OXIDE MANGANESE OXIDE SYSTEMS
IRON OXIDE MAGNESIUM OXIDE MOLYBDENUM OXIDE SYSTEMS
IRON OXIDE MAGNESIUM OXIDE ZINC OXIDE SYSTEMS
IRON OXIDE NICKEL OXIDE SYSTEMS
IRON OXIDE NICKEL OXIDE ZINC OXIDE SYSTEMS
IRON OXIDE SILICON OXIDE SYSTEMS
IRON OXIDE TELLURIUM OXIDE SYSTEMS
IRON OXIDE THORIUM OXIDE SYSTEMS
IRON OXIDE YTTRIUM OXIDE SYSTEMS
IRON OXIDE ZINC OXIDE SYSTEMS
LANTHANUM OXIDE MANGANESE OXIDE LEAD OXIDE SYSTEMS
MANGANESE OXIDE NICKEL OXIDE SYSTEMS

FERROMAGNETIC MATERIALS

ALUMINUM CARBON IRON SYSTEMS

ALUMINUM COBALT SYSTEMS

ALUMINUM COBALT COPPER IRON NICKEL SYSTEMS

ALUMINUM COBALT IRON NICKEL SYSTEMS

ALUMINUM COBALT IRON NICKEL TITANIUM SYSTEMS

ALUMINUM COBALT MANGANESE SYSTEMS

ALUMINUM COBALT NICKEL SYSTEMS

ALUMINUM COPPER IRON SYSTEMS

ALUMINUM COPPER IRON NICKEL SYSTEMS

ALUMINUM COPPER NICKEL SYSTEMS

ALUMINUM IRON SYSTEMS

ALUMINUM IRON MANGANESE SYSTEMS

ALUMINUM IRON NICKEL SYSTEMS

ALUMINUM IRON MANGANESE NICKEL SYSTEMS

ALUMINUM IRON NICKEL TITANIUM SYSTEMS

ALUMINUM IRON SILICON SYSTEMS

ALUMINUM MANGANESE NICKEL SYSTEMS

ALUMINUM MAGNESIUM SILICON SYSTEMS

ALUMINUM MANGANESE SILVER SYSTEMS

ALUMINUM NICKEL SYSTEMS

ANTIMONY CHROMIUM SYSTEMS

ANTIMONY COBALT SYSTEMS

ANTIMONY COBALT IRON SYSTEMS

ANTIMONY COPPER NICKEL SYSTEMS

ANTIMONY IRON SYSTEMS
ANTIMONY MAGNESIUM SYSTEMS
ANTIMONY NICKEL SYSTEMS
ARSENIC CHROMIUM SYSTEMS
ARSENIC COBALT SYSTEMS
ARSENIC COBALT NICKEL SYSTEMS
ARSENIC COPPER NICKEL SYSTEMS
ARSENIC IRON SYSTEMS
ARSENIC MAGNESIUM SYSTEMS
ARSENIC NICKEL SYSTEMS
BERYLLIUM COBALT SYSTEMS
BERYLLIUM COPPER NICKEL SYSTEMS
BERYLLIUM IRON SYSTEMS
BERYLLIUM IRON NICKEL SYSTEMS
BERYLLIUM NICKEL SYSTEMS
BISMUTH COBALT SYSTEMS
BISMUTH MAGNESIUM SYSTEMS
BISMUTH NICKEL SYSTEMS
BORON CARBON IRON SYSTEMS
BORON COBALT SYSTEMS
BORON IRON SYSTEMS
BORON MAGNESIUM SYSTEMS
BORON NICKEL SYSTEMS
CARBON CHROMIUM IRON TUNGSTEN SYSTEMS
CARBON COBALT SYSTEMS
CARBON COBALT IRON SYSTEMS

CARBON COPPER IRON SYSTEMS
CARBON COPPER NICKEL SYSTEMS
CARBON IRON SYSTEMS
CARBON IRON MANGANESE SYSTEMS
CARBON IRON MOLYBDENUM SYSTEMS
CARBON IRON SILICON SYSTEMS
CARBON IRON TIN ALLOYS
CARBON IRON TITANIUM SYSTEMS
CARBON IRON VANADIUM SYSTEMS
CARBON NICKEL SYSTEMS
CALCIUM MAGNESIUM SYSTEMS
CERIUM IRON SYSTEMS
CESIUM COBALT SYSTEMS
CHROMIUM COBALT SYSTEMS
CHROMIUM COPPER IRON SYSTEMS
CHROMIUM COPPER NICKEL SYSTEMS
CHROMIUM IRON SYSTEMS
CHROMIUM IRON MANGANESE ALLOYS
CHROMIUM IRON MOLYBDENUM SYSTEMS
CHROMIUM IRON MOLYBDENUM TUNGSTEN SYSTEMS
CHROMIUM IRON NICKEL SYSTEMS
CHROMIUM IRON TITANIUM SYSTEMS
CHROMIUM IRON TITANIUM TUNGSTEN SYSTEMS
CHROMIUM IRON TUNGSTEN SYSTEMS
CHROMIUM NICKEL SYSTEMS
CHROMIUM OXYGEN SYSTEMS

CHROMIUM PLATINUM SYSTEMS
CHROMIUM SELENIUM SYSTEMS
CHROMIUM SULFUR SYSTEMS
CHROMIUM THALLIUM SYSTEMS
COBALT
COBALT CHROMIUM IRON SYSTEMS
COBALT CHROMIUM IRON MOLYBDENUM SYSTEMS
COBALT CHROMIUM IRON TUNGSTEN SYSTEMS
COBALT COPPER SYSTEMS
COBALT COPPER IRON NICKEL SYSTEMS
COBALT COPPER MANGANESE ALLOYS
COBALT COPPER MOLYBDENUM SYSTEMS
COBALT COPPER NICKEL SYSTEMS
COBALT GOLD SYSTEMS
COBALT GERMANIUM SYSTEMS
COBALT HYDROGEN SYSTEMS
COBALT IRON SYSTEMS
COBALT IRON MANGANESE NICKEL SYSTEMS
COBALT IRON MANGANESE TUNGSTEN ALLOYS
COBALT IRON MANGANESE VANADIUM SYSTEMS
COBALT IRON MOLYBDENUM SYSTEMS
COBALT IRON MOLYBDENUM TUNGSTEN SYSTEMS
COBALT IRON NICKEL SYSTEMS
COBALT IRON NICKEL TITANIUM SYSTEMS
COBALT IRON SILICON SYSTEMS
COBALT IRON TANTALUM SYSTEMS

CHROMIUM PLATINUM SYSTEMS

CHROMIUM SELENIUM SYSTEMS

CHROMIUM SULFUR SYSTEMS

CHROMIUM THALLIUM SYSTEMS

COBALT

COBALT CHROMIUM IRON SYSTEMS

COBALT CHROMIUM IRON MOLYBDENUM SYSTEMS

COBALT CHROMIUM IRON TUNGSTEN SYSTEMS

COBALT COPPER SYSTEMS

COBALT COPPER IRON NICKEL SYSTEMS

COBALT COPPER MANGANESE ALLOYS

COBALT COPPER MOLYBDENUM SYSTEMS

COBALT COPPER NICKEL SYSTEMS

COBALT GOLD SYSTEMS

COBALT GERMANIUM SYSTEMS

COBALT HYDROGEN SYSTEMS

COBALT IRON SYSTEMS

COBALT IRON MANGANESE NICKEL SYSTEMS

COBALT IRON MANGANESE TUNGSTEN ALLOYS

COBALT IRON MANGANESE VANADIUM SYSTEMS

COBALT IRON MOLYBDENUM SYSTEMS

COBALT IRON MOLYBDENUM TUNGSTEN SYSTEMS

COBALT IRON NICKEL SYSTEMS

COBALT IRON NICKEL TITANIUM SYSTEMS

COBALT IRON SILICON SYSTEMS

COBALT IRON TANTALUM SYSTEMS

COBALT IRON TIN SYSTEMS
COBALT IRON TITANIUM SYSTEMS
COBALT IRON TUNGSTEN SYSTEMS
COBALT IRON VANADIUM SYSTEMS
COBALT LEAD SYSTEMS
COBALT MAGNESIUM SYSTEMS
COBALT MANGANESE SYSTEMS
COBALT MERCURY SYSTEMS
COBALT MOLYBDENUM SYSTEMS
COBALT NICKEL SYSTEMS
COBALT NICKEL SILICON SYSTEMS
COBALT NIOBIUM SYSTEMS
COBALT NITROGEN SYSTEMS
COBALT OXYGEN SYSTEMS
COBALT PALLADIUM SYSTEMS
COBALT PHOSPHORUS SYSTEMS
COBALT PLATINUM SYSTEMS
COBALT SELENIUM SYSTEMS
COBALT SILICON SYSTEMS
COBALT SILVER SYSTEMS
COBALT SULFUR SYSTEMS
COBALT TANTALUM SYSTEMS
COBALT TELLURIUM SYSTEMS
COBALT THALLIUM SYSTEMS
COBALT TIN SYSTEMS
COBALT TITANIUM SYSTEMS

COBALT TUNGSTEN SYSTEMS
COBALT VANADIUM SYSTEMS
COBALT ZINC SYSTEMS
COBALT ZIRCONIUM SYSTEMS
COPPER GOLD NICKEL SYSTEMS
COPPER IRON SYSTEMS
COPPER IRON NICKEL SYSTEMS
COPPER MANGANESE NICKEL SYSTEMS
COPPER MANGANESE TIN SYSTEMS
COPPER IRON MOLYBDENUM SYSTEMS
COPPER IRON MOLYBDENUM NICKEL SYSTEMS
COPPER IRON NICKEL SYSTEMS
COPPER IRON NICKEL VANADIUM SYSTEMS
COPPER MOLYBDENUM NICKEL SYSTEMS
COPPER NICKEL SYSTEMS
GALLIUM NICKEL SYSTEMS
GERMANIUM NICKEL SYSTEMS
GOLD NICKEL SYSTEMS
HYDROGEN NICKEL SYSTEMS
HYDROGEN MAGNESIUM SYSTEMS
IODINE NICKEL SYSTEMS
IRON
IRON GADOLINIUM SYSTEMS
IRON GERMANIUM SYSTEMS
IRON HYDROGEN SYSTEMS

IRON LITHIUM SYSTEMS
INDIUM MAGNESIUM SYSTEMS
IRON MAGNESIUM NICKEL SYSTEMS
IRON MAGNESIUM ZINC SYSTEMS
IRON MANGANESE SYSTEMS
IRON MANGANESE MOLYBDENUM NICKEL SYSTEMS
IRON MANGANESE TITANIUM SYSTEMS
IRON MANGANESE VANADIUM SYSTEMS
IRON MANGANESE ZINC SYSTEMS
IRON MERCURY SYSTEMS
IRON MOLYBDENUM SYSTEMS
IRON MOLYBDENUM NICKEL SYSTEMS
IRON MOLYBDENUM VANADIUM SYSTEMS
IRON NEODYMIUM SYSTEMS
IRON NICKEL SYSTEMS
IRON NICKEL SILICON SYSTEMS
IRON NICKEL SILVER SYSTEMS
IRON NICKEL TANTALUM SYSTEMS
IRON NICKEL TIN SYSTEMS
IRON NICKEL TITANIUM SYSTEMS
IRON NICKEL TUNGSTEN SYSTEMS
IRON NICKEL VANADIUM SYSTEMS
IRON NIOBIUM SYSTEMS
IRON NITROGEN SYSTEMS
IRON OXYGEN SYSTEMS
IRON PALLADIUM SYSTEMS

IRON PHOSPHORUS SYSTEMS
IRON PLATINUM SYSTEMS
IRON SELENIUM SYSTEMS
IRON SILICON SYSTEMS
IRON SULFUR SYSTEMS
IRON TANTALUM SYSTEMS
IRON TIN SYSTEMS
IRON TITANIUM TUNGSTEN SYSTEMS
IRON TUNGSTEN SYSTEMS
IRON TUNGSTEN VANADIUM SYSTEMS
IRON URANIUM SYSTEMS
IRON VANADIUM SYSTEMS
IRON ZINC SYSTEMS
IRON ZIRCONIUM SYSTEMS
MANGANESE COPPER ALUMINUM SYSTEMS
MAGNESIUM
MAGNESIUM NICKEL SYSTEMS
MAGNESIUM NITROGEN SYSTEMS
MAGNESIUM OXYGEN SYSTEMS
MAGNESIUM PHOSPHORUS SYSTEMS
MAGNESIUM TIN SYSTEMS
MERCURY NICKEL SYSTEMS
MOLYBDENUM NICKEL SYSTEMS
NICKEL
NICKEL NIOBIUM SYSTEMS
NICKEL NITROGEN SYSTEMS

NICKEL OXYGEN SYSTEMS
NICKEL PALLADIUM SYSTEMS
NICKEL PHOSPHORUS SYSTEMS
NICKEL PLATINUM SYSTEMS
NICKEL SELENIUM SYSTEMS
NICKEL SILICON SYSTEMS
NICKEL SILVER SYSTEMS
NICKEL SULFUR SYSTEMS
NICKEL TANTALUM SYSTEMS
NICKEL TELLURIUM SYSTEMS
NICKEL THALLIUM SYSTEMS
NICKEL TIN SYSTEMS
NICKEL TITANIUM SYSTEMS
NICKEL TUNGSTEN SYSTEMS
NICKEL VANADIUM SYSTEMS
NICKEL ZINC SYSTEMS
NICKEL ZIRCONIUM SYSTEMS

SUPERCONDUCTOR MATERIALS

ALUMINUM

ALUMINUM NIOBIUM SYSTEMS

ALUMINUM OSMIUM SYSTEMS

ALUMINUM SILICON VANADIUM SYSTEMS

ANTIMONY ARSENIC BISMUTH LEAD SYSTEMS

ANTIMONY BISMUTH LEAD SYSTEMS

ANTIMONY LEAD SYSTEMS

ANTIMONY MOLYBDENUM SYSTEMS

ANTIMONY PALLADIUM SYSTEMS

ANTIMONY PLATINUM SYSTEMS

ANTIMONY THALLIUM SYSTEMS

ANTIMONY TIN SYSTEMS

ANTIMONY TITANIUM SYSTEMS

ARSENIC BISMUTH LEAD SYSTEMS

ARSENIC LEAD SYSTEMS

ARSENIC NICKEL PALLADIUM SYSTEMS

ARSENIC TIN SYSTEMS

BARIUM BISMUTH SYSTEMS

BARIUM RHODIUM SYSTEMS

BERYLLIUM

BERYLLIUM GOLD SYSTEMS

BISMUTH

BISMUTH CADMIUM LEAD TIN SYSTEMS

BISMUTH CALCIUM SYSTEMS

BISMUTH CESIUM SYSTEMS
BISMUTH COPPER SYSTEMS
BISMUTH GOLD SYSTEMS
BISMUTH INDIUM SYSTEMS
BISMUTH LEAD SYSTEMS
BISMUTH LEAD TIN SYSTEMS
BISMUTH LITHIUM SYSTEMS
BISMUTH NICKEL SYSTEMS
BISMUTH PALLADIUM SYSTEMS
BISMUTH PLATINUM SYSTEMS
BISMUTH POTASSIUM SYSTEMS
BISMUTH RHODIUM SYSTEMS
BISMUTH RUBIDIUM SYSTEMS
BISMUTH SODIUM SYSTEMS
BISMUTH STRONTIUM SYSTEMS
BISMUTH THALLIUM SYSTEMS
BISMUTH TIN SYSTEMS
BISMUTH YTTRIUM SYSTEMS
BORON MOLYBDENUM SYSTEMS
BORON NIOBIUM SYSTEMS
BORON RHENIUM SYSTEMS
BORON RUTHENIUM SYSTEMS
BORON TANTALUM SYSTEMS
BORON TUNGSTEN SYSTEMS
BORON ZIRCONIUM SYSTEMS
BORON SILICON VANADIUM SYSTEMS

CADMIUM

CADMIUM LEAD SYSTEMS

CADMIUM MERCURY SYSTEMS

CADMIUM THALLIUM SYSTEMS

CALCIUM IRIIDIUM SYSTEMS

CALCIUM LEAD SYSTEMS

CALCIUM RHODIUM SYSTEMS

CARBON MOLYBDENUM NIOBIUM SYSTEMS

CARBON MOLYBDENUM SYSTEMS

CARBON MOLYBDENUM TANTALUM SYSTEMS

CARBON NIOBIUM NITROGEN SYSTEMS

CARBON NIOBIUM SYSTEMS

CARBON NITROGEN NIOBIUM SYSTEMS

CARBON SILICON VANADIUM SYSTEMS

CARBON TANTALUM SYSTEMS

CARBON TANTALUM TUNGSTEN SYSTEMS

CARBON TUNGSTEN SYSTEMS

CERIUM GADOLINIUM RUTHENTIUM SYSTEMS

CERIUM LANTHANUM SYSTEMS

CERIUM PRASEODYMIUM RUTHENIUM SYSTEMS

CERIUM RUTHENIUM SYSTEMS

CHROMIUM SILICON VANADIUM SYSTEMS

CHROMIUM TITANIUM SYSTEMS

COBALT IRON SILICON SYSTEMS

COBALT NICKEL SILICON SYSTEMS

COBALT RHODIUM SILICON SYSTEMS

COBALT SILICON SYSTEMS
COBALT THORIUM SYSTEMS
COBALT TIN SYSTEMS
COBALT TITANIUM SYSTEMS
COBALT URANIUM SYSTEMS
COBALT ZIRCONIUM SYSTEMS
COPPER LEAD SYSTEMS
COPPER SULFIDE
COPPER THORIUM SYSTEMS
COPPER TIN SYSTEMS
DYSPROSIUM LANTHANUM SYSTEMS
ERBIUM LANTHANUM SYSTEMS
EUROPIUM LANTHANUM SYSTEMS
GADOLINIUM LANTHANUM OSMIUM SYSTEMS
GADOLINIUM LANTHANUM SYSTEMS
GADOLINIUM OSMIUM YTTRIUM SYSTEMS
GADOLINIUM RUTHENIUM THORIUM SYSTEMS
GALLIUM
GALLIUM MOLYBDENUM SYSTEMS
GALLIUM NIOBIUM SYSTEMS
GALLIUM VANADIUM SYSTEMS
GERMANIUM IRIIDIUM SYSTEMS
GERMANIUM LANTHANUM SYSTEMS
GERMANIUM MOLYBDENUM SYSTEMS
GERMANIUM NIOBIUM SYSTEMS
GERMANIUM RHODIUM SYSTEMS

GERMANIUM SCANDIUM SYSTEMS
GERMANIUM SILICON VANADIUM SYSTEMS
GERMANIUM TANTALUM SYSTEMS
GERMANIUM VANADIUM SYSTEMS
GERMANIUM YTTRIUM SYSTEMS
GOLD LEAD SYSTEM
GOLD NIOBIUM SYSTEM
GOLD TELLURIUM SYSTEMS
GOLD THORIUM SYSTEMS
GOLD TIN SYSTEMS
GOLD ZIRCONIUM SYSTEMS
HAFNIUM
HAFNIUM MOLYBDENUM SYSTEMS
HAFNIUM OSMIUM SYSTEMS
HAFNIUM RHENIUM SYSTEMS
HAFNIUM RHODIUM SYSTEMS
HAFNIUM ZIRCONIUM SYSTEMS
HOLMIUM LANTHANUM SYSTEMS
HYDROGEN NIOBIUM SYSTEMS
HYDROGEN TANTALUM SYSTEMS
INDIUM
INDIUM LANTHANUM SYSTEMS
INDIUM LEAD SYSTEMS
INDIUM MERCURY SYSTEMS
INDIUM THALLIUM SYSTEMS
INDIUM TIN SYSTEMS

IRIDIUM MOLYBDENUM SYSTEMS
IRIDIUM NIOBIUM SYSTEMS
IRIDIUM OSMIUM YTTRIUM SYSTEMS
IRIDIUM SCANDIUM SYSTEMS
IRIDIUM STRONTIUM SYSTEMS
IRIDIUM THORIUM SYSTEMS
IRIDIUM TITANIUM SYSTEMS
IRIDIUM TUNGSTEN SYSTEMS
IRIDIUM VANADIUM SYSTEMS
IRIDIUM YTTRIUM SYSTEMS
IRIDIUM ZIRCONIUM SYSTEMS
IRON LANTHANUM SYSTEMS
IRON MANGANESE SILICON VANADIUM SYSTEMS
IRON NICKEL ZIRCONIUM SYSTEMS
IRON THORIUM SYSTEMS
IRON TITANIUM SYSTEMS
IRON TITANIUM VANADIUM SYSTEMS
IRON URANIUM SYSTEMS
IRON ZIRCONIUM SYSTEMS
LANTHANUM
LANTHANUM LUTETIUM SYSTEMS
LANTHANUM NEODYMIUM SYSTEMS
LANTHANUM OSMIUM SYSTEMS
LANTHANUM PRASEODYMIUM SYSTEMS
LANTHANUM RUTHENIUM SYSTEMS
LANTHANUM SAMARIUM SYSTEMS

LANTHANUM TERBIUM SYSTEMS
LANTHANUM YTTERBIUM SYSTEMS
LANTHANUM YTTRIUM SYSTEMS
LEAD
LEAD LITHIUM SYSTEMS
LEAD MERCURY SYSTEMS
LEAD NITROGEN SYSTEMS
LEAD PHOSPHORUS SYSTEMS
LEAD SILVER SYSTEMS
LEAD SULFUR SYSTEMS
LEAD THALLIUM SYSTEMS
LUTETIUM OSMIUM SYSTEMS
MAGNESIUM THALLIUM SYSTEMS
MANGANESE TITANIUM SYSTEMS
MANGANESE URANIUM SYSTEMS
MERCURY
MERCURY THALLIUM SYSTEMS
MOLYBDENUM BORIDE
MOLYBDENUM CARBIDE
MOLYBDENUM NIOBIUM SYSTEMS
MOLYBDENUM NITROGEN SYSTEMS
MOLYBDENUM OSMIUM SYSTEMS
MOLYBDENUM PHOSPHORUS SYSTEMS
MOLYBDENUM RHENIUM SYSTEMS
MOLYBDENUM RHODIUM SYSTEMS

MOLYBDENUM RUTHENIUM SYSTEMS
MOLYBDENUM SILICON SYSTEMS
MOLYBDENUM SILICON VANADIUM SYSTEMS
MOLYBDENUM TECHNETIUM SYSTEMS
MOLYBDENUM TITANIUM SYSTEMS
MOLYBDENUM URANIUM SYSTEMS
MOLYBDENUM VANADIUM SYSTEMS
NICKEL THORIUM SYSTEMS
NICKEL ZIRCONIUM SYSTEMS
NIOBIUM
NIOBIUM BORIDE
NIOBIUM CARBIDE
NIOBIUM NITROGEN SYSTEMS
NIOBIUM OSMIUM SYSTEMS
NIOBIUM PALLADIUM SYSTEMS
NIOBIUM PLATINUM SYSTEMS
NIOBIUM THENIUM SYSTEMS
NIOBIUM RHODIUM SYSTEMS
NIOBIUM SILVER SYSTEMS
NIOBIUM SILICON VANADIUM SYSTEMS
NIOBIUM TANTALUM SYSTEMS
NIOBIUM TANTALUM TIN SYSTEMS
NIOBIUM TECHNETIUM SYSTEMS
NIOBIUM TIN SYSTEMS
NIOBIUM TIN VANADIUM SYSTEMS
NIOBIUM URANIUM SYSTEMS

NIObIUM ZIRCONIUM ALLOYS
NITROGEN OXYGEN TITANIUM SYSTEMS
NITROGEN OXYGEN VANADIUM SYSTEMS
NITROGEN RHENIUM SYSTEMS
NITROGEN TITANIUM SYSTEMS
NITROGEN VANADIUM SYSTEMS
NITROGEN ZIRCONIUM SYSTEMS
OSMIUM
OSMIUM RHENIUM YTTRIUM SYSTEMS
OSMIUM SCANDIUM SYSTEMS
OSMIUM TANTALUM SYSTEMS
OSMIUM THORIUM SYSTEMS
OSMIUM TUNGSTEN SYSTEMS
OSMIUM YTTRIUM SYSTEMS
OSMIUM ZIRCONIUM SYSTEMS
PALLADIUM RUBIDIUM ZIRCONIUM SYSTEMS
PALLADIUM SELENIUM SYSTEMS
PALLADIUM TELLURIUM SYSTEMS
PALLADIUM ZIRCONIUM SYSTEMS
PHOSPHORUS RHODIUM SYSTEMS
PHOSPHORUS TUNGSTEN SYSTEMS
PLATINUM TANTALUM SYSTEMS
PLATINUM VANADIUM SYSTEMS
PLATINUM YTTRIUM SYSTEMS
PLATINUM ZIRCONIUM SYSTEMS

RHENIUM

RHENIUM TANTALUM SYSTEMS

RHENIUM TITANIUM SYSTEMS

RHENIUM TUNGSTEN SYSTEMS

RHENIUM YTTRIUM SYSTEMS

RHENIUM ZIRCONIUM SYSTEMS

RHODIUM

RHODIUM SELENIDE

RHODIUM STRONTIUM SYSTEMS

RHODIUM SULFUR SYSTEMS

RHODIUM TANTALUM SYSTEMS

RHODIUM TELLURIDE

RHODIUM TITANIUM SYSTEMS

RHODIUM TUNGSTEN SYSTEMS

RHODIUM ZIRCONIUM SYSTEMS

RUTHENIUM

RUTHENIUM SCANDIUM SYSTEMS

RUTHENIUM SILICON VANADIUM SYSTEMS

RUTHENIUM THORIUM SYSTEMS

RUTHENIUM TITANIUM SYSTEMS

RUTHENIUM TITANIUM VANADIUM SYSTEMS

RUTHENIUM TUNGSTEN SYSTEMS

RUTHENIUM YTTRIUM SYSTEMS

RUTHENIUM ZIRCONIUM SYSTEMS

SILICON THORIUM SYSTEMS

SILICON TUNGSTEN SYSTEMS

SILICON VANADIUM SYSTEMS
SILICON TITANIUM VANADIUM SYSTEMS
SILICON VANADIUM ZIRCONIUM SYSTEMS
SILVER THALLIUM SYSTEMS
SILVER THORIUM SYSTEMS
SILVER TIN SYSTEMS
SILVER ZINC SYSTEMS
TANTALUM
TANTALUM BORIDE
TANTALUM CARBIDE
TANTALUM TIN SYSTEMS
TANTALUM TIN VANADIUM SYSTEMS
TECHNETIUM
TECHNETIUM ZIRCONIUM SYSTEMS
THALLIUM
THALLIUM TIN SYSTEMS
THORIUM
TIN
TIN VANADIUM SYSTEMS
TITANIUM
TITANIUM NITRIDE
TITANIUM VANADIUM SYSTEMS
TITANIUM ZIRCONIUM SYSTEMS
TUNGSTEN BORIDE
TUNGSTEN CARBIDE
TUNGSTEN NITRIDE

TUNGSTEN ZIRCONIUM SYSTEMS

URANIUM

VANADIUM

VANADIUM NITRIDE

VANADIUM ZIRCONIUM SYSTEMS

ZINC

ZIRCONIUM

ZIRCONIUM BORIDE

ZIRCONIUM NITRIDE

D. Metals and Alloys Materials List

By definition, a metal is an element capable of conducting an electrical current. This it does by virtue of its free electrons able to move throughout the lattice with minimum energy loss. We have accordingly determined to confine our selection of data to information concerning the variations of this basic ability, and limited to materials used in, or forming part of an electric circuit. If this seems too confining, one should realize that other properties are covered in other categories of materials where metals and alloys also frequently occur, e. g., semiconductors, ferromagnetics and superconductors (to name a few).

The initial list of materials covers 108 metals and alloys with the most used trade names of alloys where the composition is known. The list will be adjusted as experience indicates by frequency of occurrence of articles on any particular types of alloys. Where any grouping, for example "copper alloys", becomes too densely populated, it will be divided and indexed by composition, first by primary alloying element and, if necessary, then by percentage composition naming the constituent elements down to a 1% level.

METALS AND ALLOYS MATERIALS

Alumel

See NICKEL ALLOYS

ALUMINUM

ALUMINUM ALLOYS

Aluminum Bronze

See COPPER ALLOYS

ANTIMONY

ARSENIC

Balco

See NICKEL ALLOYS

BARIUM

BERYLLIUM

Beryllium Copper

See COPPER ALLOYS

BISMUTH

Brass

See COPPER ALLOYS

Bronze

See COPPER ALLOYS

CADMIUM

CALCIUM

CERIUM

CESIUM

Chromel

See NICKEL ALLOYS

CHROMIUM

CHROMIUM ALLOYS

COBALT

Columbium

See NIOBIUM

Constantan

See COPPER ALLOYS

COPPER

COPPER ALLOYS

Copperweld

See COPPER ALLOYS

DYSPROSIUM

ERBIUM

EUROPIUM

GADOLINIUM

GALLIUM

GERMANIUM

GOLD

GOLD ALLOYS

HAFNIUM

HOLMIUM

Inconel

See NICKEL ALLOYS

INDIUM

INDIUM ALLOYS

IRIDIUM

IRON

IRON ALLOYS

LANTHANUM

LEAD

LEAD ALLOYS

LITHIUM

LUTETIUM

MAGNESIUM

MAGNESIUM ALLOYS

MANGANESE

Manganin

See COPPER ALLOYS

MERCURY

MERCURY ALLOYS + AMALGAMS

MOLYBDENUM

MOLYBDENUM ALLOYS

Monel

See NICKEL ALLOYS

NEODYMIUM

Nichrome

See NICKEL ALLOYS

NICKEL

NICKEL ALLOYS

Nickel Silver

See COPPER ALLOYS

NIOBIUM (COLUMBIUM)

NIOBIUM ALLOYS

OSMIUM

PALLADIUM

PALLADIUM ALLOYS

Phosphor Bronze

See COPPER ALLOYS

PLATINUM
PLATINUM ALLOYS
PLUTONIUM
POTASSIUM
PRASEODYMIUM
RHENIUM
RHENIUM ALLOYS
RHODIUM
RHODIUM ALLOYS
RUBIDIUM
RUTHENIUM
RUTHENIUM ALLOYS
SAMARIUM
SCANDIUM
SELENIUM
SILICON
SILVER
SILVER ALLOYS
SODIUM
Stainless Steel
 See IRON ALLOYS
Steels
 See IRON
TANTALUM
TANTALUM ALLOYS
TELLURIUM

TERBIUM

THALLIUM

Thoriated Tungsten
See TUNGSTEN ALLOYS

THORIUM

THULIUM

TIN

TIN ALLOYS

TITANIUM

TITANIUM ALLOYS

TUNGSTEN

TUNGSTEN ALLOYS

URANIUM

URANIUM ALLOYS

VANADIUM

VANADIUM ALLOYS

WOLFRAM
See TUNGSTEN

YTTERBIUM

YTTRIUM

ZINC

ZINC ALLOYS

ZIRCONIUM

ZIRCONIUM ALLOYS

E. Organic Semiconductors Materials List

Development of a list of organic semiconductors involved the following sequence:

1. Investigation of the theory to determine the nature of an organic semiconductor.
2. Recognition of the unpredictable approach of authors writing in this field.
3. Selecting the list from texts, reports and articles considered authoritative.
4. Recognition of the nature of the organic compound from its name or formula. The structural formula is necessary to set up a generic compound and its derivatives. Some 400 names have been selected from the aromatic-ring compounds. The aliphatic-chain compounds are not semiconductors, so are not included.

It is essential to note that merely searching the literature for data on the various electronic properties of organic compounds is not satisfactory. The dielectric constant, in particular, has proven very efficient in the determination of organic structure, but since chain compounds (aliphatics) are not semiconductors, literature on them is useless for our purposes despite the enormous amount of it. The searcher must recognize the nature of the organic compound from its name or formula.

Organic naming, and chemical nomenclature in general, is in a considerable state of flux at the present. It seemed reasonable to show the true structure for each organic compound selected. This would define the compound exactly and leave no room for doubt or error. The job is not yet finished; however, eventually every compound will have a structural formula, if known.

The structural formula is necessary to set up a generic compound and its derivatives. However, in cases where the derivative is important in its own right, it is kept separately.

The first step in setting up a catalogue of names for the organic semiconductors was to investigate the theory and determine the nature of an organic semiconductor. It is a frequently unrecognized fact that data retrieval does not bear any resemblance to an assembly line production. A person's ability to write does not qualify him to select materials and properties according to a specific list. There are several reasons for this discontinuity. The most vital one is that every author is a distinct individual and therefore he usually presents his material in a unique manner. There are as many ways of plotting

experimental data on a graph as there are investigators, and the extractor must know the possible parameters in any given region to reduce this material to intelligibility. For example, the exact nature of the sample is rarely specified directly, data is rarely tabulated and results are frequently rationalized. Only a thorough knowledge of the field allows the extractor to extract information efficiently.

ORGANIC SEMICONDUCTOR MATERIALS

ACENAPHTHENE

7-Acenaphthol

See NAPHTHOL

ACENAPHTHRENE

ACENAPHTHRENE-COMPLEXES

ACETYLENE

ACIDENE COMPLEXES

Acidene-iodine

See ACIDENE COMPLEXES

Acidene Iodine Monochloride

See ACIDENE COMPLEXES

ACRIDINE

ACRYLIC ACID

ACRYLONITRILE

ACTOMYOSIN

AETIOPORPHORYN

Aetioporphoryn-cobalt Iodide

Aetioporphoryn-copper Iodide

Aetioporphoryn Iodine

See AETIOPORPHORYN

Aetioporphoryn-magnesium Iodide

See AETIOPORPHORYN

Aetioporphoryn-nickel Iodide

See AETIOPORPHORYN

ALANINE

ALBUMEN

Alizarin

See ANTHRAQUINONE

Aminonaphthalene

See NAPHTHALENE

Amino-pyrene

See PYRENE

ANILINE COMPLEXES

ANISIDINE COMPLEXES

ANTHANTHRENE

ANTHANTHRONE

ANTHRACENE

ANTHRACENE, ALKALI DERIVATIVE

ANTHRADIPYRIMIDINE

Anthrarufin

See ANTHRAQUINONE

ANTHRAQUINONE

ANTHRENE

ANTHRONE

AZOCARMINE

AZULENE COMPLEXES

BENZANTHRACENE

BENZANTHRENE

BENZANTHRONE

BENZENE COMPLEXES

BENZIDINE

Benzidine-Br₂

See BENZIDINE COMPLEXES

BENZIDINE COMPLEXES

Benzidine-I₂

See BENZIDINE COMPLEXES

Benzidine-tetranitromethane

See BENZIDINE COMPLEXES

Benzidine-1, 3, 5 Trinitrobenzene

See BENZIDINE COMPLEXES

BENZIMIDAZOLE

BENZOPERYLENE

1, 2-Benzoperylene Quinone

See BENZOPERYLENE

3, 4-Benzoquinoline-Br₂

See BENZOQUINOLINE COMPLEXES

BENZOQUINOLINE COMPLEXES

BENZOQUINONE

Bilirubin

See PORPHYRINS

BIPHENYL

1, 4 Bisanthraquinonyl Amino Anthraquinone

See ANTHRAQUINONE

Bovine Plasma Albumen

See ALBUMEN

BRILLIANT GREEN

Bromeosin

See EOSIN

1-Bromo-2-Naphthol

See NAPHTHOL

6-Bromo-2-Naphthol

See NAPHTHOL

9-Bromo-phenanthrene

See PHENANTHRENE

2-Bromo-4-Phenyl Phenol

See PHENOL

Cadmium Polyacrylonitrile
 See POLYACRYLONITRILE

CARBAZOLE

CAROTENE

CAROTENE HALOGEN COMPLEXES

β -Carotene-iodine
 See CAROTENE HALOGEN COMPLEXES

CELLULOSE

Chloranil-p-aminodiphenylamine
 See PHENYLENE COMPLEXES

Chloranil-p-anisidine
 See ANISIDINE COMPLEXES

Chlorophyll, α or β
 See PORPHYRINS

Chrysazin
 See ANTHRAQUINONE

CHRYSENE

COBALT PHTHALOCYANINE

COPPER PHTHALOCYANINE

COPPER- Cl_2 PHTHALOCYANINE

Copper Chloride Polyacrylonitrile
 See POLYACRYLONITRILE

Copper Polyacrylonitrile
 See POLYACRYLONITRILE

Copper-tetrapyrazino-porphyrazine
 See PORPHYRAZINE

Copper-tetrapyridino-porphyrazine
 See PORPHYRAZINE

COPROPORPHYRIN III

CORONENE

CORONENE COMPLEXES

Coronene-iodine

See CORONENE COMPLEXES

Coronene-picric Acid

See CORONENE COMPLEXES

Coronene-1, 3, 5-trinitrobenzene

See CORONENE COMPLEXES

CRYSTAL VIOLET

Crystal Violet Oxalate

See CRYSTAL VIOLET

Crystal Violet Sulfate

See CRYSTAL VIOLET

CYANTHRONE

CYTOCHROME C

DNA DEOXYRIBONUCLEIC ACID

2,4-DIAMINOAZOBENZENE HYDROCHLORIDE

4,4'-Diaminodiphenyl

See BENZIDINE

Diaminodurene-chloranil

See DURENE HALOGEN COMPLEXES

1,5-Diaminonaphthalene-chloranil

See NAPHTHALENE COMPLEXES

3,8-Diaminopyrene Bromanil

See PYRENE COMPLEXES

1,6-Diaminopyrene Chloranil

See PYRENE COMPLEXES

3,8-Diaminopyrene-chloranil

See PYRENE COMPLEXES

3,10-Diaminopyrene Chloranil

See PYRENE COMPLEXES

3,8-Diaminopyrene Iodanil

See PYRENE COMPLEXES

1,2-Dibenzanthracene
 See BENZANTHRACENE

1,2,5,6-Dibenzanthracene
 See BENZANTHRACENE

Dibenzanthrone
 See BENZANTHRONE

Dibenzoperylene
 See BENZOPERYLENE

Dibromoperylene
 See PERYLENE COMPLEXES

Dibenzopyrrole
 See CARBAZOLE

Dibenzothiophene
 See THIOPHENE

9,10 Dichloroanthracene
 See ANTHRACENE

DICYANINE

1,2 Dihydroxyanthraquinone
 See ANTHRAQUINONE

1,4 Dihydroxyanthraquinone
 See ANTHRAQUINONE

1,5 Dihydroxyanthraquinone
 See ANTHRAQUINONE

1,8 Dihydroxyanthraquinone
 See ANTHRAQUINONE

1,4 Dihydroxynaphthalene
 See NAPHTHALENE COMPLEXES

2,7 Dihydroxynaphthalene
 See NAPHTHALENE COMPLEXES

DIKETOPIPERAZINE DKP

Dimethylaniline-bromanil
 See ANILINE COMPLEXES

Dimethylaniline-chloranil
 See ANILINE COMPLEXES

Dimethylaniline Iodanil
See ANILINE COMPLEXES

m-Dinaphthdianthrene
See ANTHRENE

m-Dinaphthanthrone
See ANTHRONE

Diphenyl
See BIPHENYL

DIPHENYLENE

2, 2-DIPHENYL 1-PICRYL HYDRAZYL

α - α -DIPHENYL PICRYL HYDRAZYL

α , α -DIPHENYL- β -PICRYL HYDRAZYL

1, 4-Diphenyl Piperazine
See PIPERAZINE

4, 4'' Diphenyl Stilbene
See STILBENE

DIPYRROMETHENE

Distearyl-perylene
See PERYLENE

DURENE

DURENE HALOGEN COMPLEXES

EDESTIN

EOSIN

ERYTHROSIN (Na)

FERRIBEM

FERRIC ACETYLACETONATE

FLAVANTHRONE

Ferric Haem
See HAEM

FERROCENE

FIBRINOGEN

FLUORENE

FLUORENONE

FLUORESCEIN

FUCHSINE

GELATIN

GLOBIN

GLYCINE

Glycine Copper Chelate
See GLYCINE

GRAPHITE-PYROLYTIC

HAEM

Haemin
See PORPHYRINS

HEMOGLOBIN

Herring Sperm
See DNA

HYDROVIOANTHRONE

1-Hydroxyanthraquinone
See ANTHRANQUINONE

IMIDAZOLE

INDANTHRAZINE

INDANTHRONE

INDANTHRONE BLACK

INDIGO

INSULIN

Iron-polyacrylonitrile
See POLYACRYLONITRILE

Isodibenzanthrone
See BENZANTHRONE

ISODOPSIN

ISOVIOLANTHRENE

ISOVIOLANTHRONE

KRYPTO CYANINE

Lithium Anthracene
See ANTHRACENE, ALKALI DERIVATIVE

LYSOZYME

MAGNESIUM PHTHALOCYANINE

MALACHITE GREEN

MESONAPHTHODIANTHRENE

MESONAPHTHODIANTHRONE

2-Methyl-naphthylamine
See NAPHTHYLAMINE

METHYL VIOLET

MYOSIN

NAPHTHACENE

NAPHTHALENE

NAPHTHALENE COMPLEX

Naphthalene Picrate
See PICRIC ACID

NAPHTHOBENZENE (P)

NAPHTHODIANTHRENE

NAPHTHODIANTHRONE

m -Naphthodianthrone
See ANTHRONE

NAPHTHOL

NAPHTHOL ORANGE

Naphthalene Picrate
See NAPHTHALENE

NAPHTHYLAMINE

1 -Naphthylamine
See NAPHTHYLAMINE

2 -Naphthyl Phenyl Sulfone
See NAPHTHYL COMPLEXES

1 -Naphthylamine Pierate
See NAPHTHYLAMINE

NAPHTHYL COMPLEXES

NEOFORMAZAN POLYMER

NICKEL PHTHALOCYANINE

NUCLEIC ACID

Octahydroviolanthrene
See VIOLANTHRENE

OVALENE

OXAMIDE

OXAZINE

Penicillum
See DNA

PENTACENE

PERYLENE

Perylene-Bromine

See **PERYLENE COMPLEXES**

PERYLENE COMPLEXES

Perylene-iodine

See **PERYLENE COMPLEXES**

PHENANTHRENE

PHENAZINE

PHENOL

PHENOLPHTHALEIN

Phenylbenzene

See **BIPHENYL**

PHENYLENE COMPLEXES

p-Phenylenediamine-chloranil

See **PHENYLENE COMPLEXES**

4-Phenyl Stilbene

See **STILBENE**

PHTHALIC ACID (o)

PHTHALIC ANHYDRIDE

Phthalic Anhydride-hydroquinone

See **PHTHALIC ANHYDRIDE**

Phthalic Anhydride-hydroquinone-glycerine

See **PHTHALIC ANHYDRIDE**

PHTHALOCYANINE METAL FREE

PICRIC ACID

Pig Insulin

See **INSULIN**

PINACYANOLE (CL)

PIPERAZINE

PERYLENE

Perylene-Bromine

See PERYLENE COMPLEXES

PERYLENE COMPLEXES

Perylene-iodine

See PERYLENE COMPLEXES

PHENANTHRENE

PHENAZINE

PHENOL

PHENOLPHTHALEIN

Phenylbenzene

See BIPHENYL

PHENYLENE COMPLEXES

p-Phenylenediamine-chloranil

See PHENYLENE COMPLEXES

4-Phenyl Stilbene

See STILBENE

PHTHALIC ACID (o)

PHTHALIC ANHYDRIDE

Phthalic Anhydride-hydroquinone

See PHTHALIC ANHYDRIDE

Phthalic Anhydride-hydroquinone-glycerine

See PHTHALIC ANHYDRIDE

PHTHALOCYANINE METAL FREE

PICRIC ACID

Pig Insulin

See INSULIN

PINACYANOLE (CL)

PIPERAZINE

Plasma Albumen

See ALBUMEN

PLATINUM PHTHALOCYANINE

Polyacetylene

See ACETYLENE

POLYACRYLIC ACID-DIVINYL BENZENE (Ni-doped)

Polyacrylacetylene

See ACETYLENE
ACRYLIC ACID

POLYACRYLONITRILE METAL FREE

POLYAMIDES

Polyaminoquinone

See Quinone

POLYCYCLOPENTADIENE

POLY 3-CYCLOPENTA 2', 4'/DIENYL CYCLOPENTANOL

POLYCYCLOPENTAMETHYLENE FULVENE

POLYCYCLOPENTENYL CHLORIDE

POLYDIVINYL BENZENE

Polydivinyl Benzene-chlorinated

See POLYDIVINYL BENZENE

Polydivinyl Benzene-oxidized

See POLYDIVINYL BENZENE

POLYFERROCENE

Polyferrocene Benzal

See POLYFERROCENE

Polyvinyl Ferrocene

See POLYFERROCENE

POLYPERCYANOETHYLENE

Polycercyanoethylene-copper Chelate

See POLYPERCYANOETHYLENE

POLYPHENYLACETYLENE

POLYPHENYLENEQUINONE

Polyphthalocyanine

See **PTHALOCYANINE**

Polyquinolphthalein

See **QUINOLPHTHALEIN**

Polystyrene

See **STYRENE**

POLYTETRABUTYL TIN

Polytetrachlorophenyl

See **TETRACHLOROPHENYL**

POLYTRIBUTYL TIN METHACRYLATE

Polytributyl Tin Methacrylate-iodine

See **POLYTRIBUTYL TIN METHACRYLATE**

POLYTRICHLOROACETIC ACID

Polytrivinyl Benzene

See **POLYVINYL COMPOUNDS**

Polyvinyl Chloride

See **POLYVINYL COMPOUNDS**

POLYVINYL COMPOUNDS

Polyvinyl Ferrocene

See **FERROCENE**

Polyvinyl Hydroquinone

See **POLYVINYL COMPOUNDS**

POLYVINYLIDENE CHLORIDE

Poly n-vinyl-5-methyl-2

See **POLYVINYL COMPOUNDS**

Polyxanthane

See **XANTHANE**

PORPHYRAZINE

PORPHYRINS

Potassium Anthracene

See ANTHRACENE, ALKALI DERIVATIVE

Pyradazine

See PYRIMIDINE

PYRANTHRENE

PYRANTHRONE

Pyrazine

See PYRIMIDINE

PYRAZOLE

PYRENE

PYRENE COMPLEXES

PYRIDINE

5, 6 (N)-pyridino-1, 9-benzanthrene

See BENZANTHRENE

PYRIMIDINE

PYRROLE

Pyrromethane-cobalt

See PYRROMETHANE COMPLEXES

PYRROMETHANE COMPLEXES

Pyrromethane-copper

See PYRROMETHANE COMPLEXES

Pyrromethane Hydrogen Bromide

See PYRROMETHANE COMPLEXES

Pyrromethane-nickel

See PYRROMETHANE COMPLEXES

Pyrromethane-zinc

See PYRROMETHANE COMPLEXES

QUINOLINE

QUINOLPHTHALEIN

QUINONE

Quinizarin

See ANTHRAQUINONE

Rabbit Myosin

See MYOSIN

RHODOPSIN

RNA RIBONUCLEIC ACID

ROSE BENGAL

RUBEANATO-COPPER POLYMER

Serum Albumen

See ALBUMEN

SILK

Silver Polyacrylonitrile

See POLYACRYLONITRILE

Sodium Anthracene

See ANTHRACENE , ALKALI DERIVATIVE

Sodium-3, 4-benzoquinoline

See BENZOQUINOLINE COMPLEX

STILBENE

STYRENE

Styrene-acrylonitrile co-polymer

See POLYACRYLONITRILE

TERPHENYL

Tetrabromofluorescein

See EOSIN

TETRACENE

TETRACHLORPHENYL

Tetracyanoethylene-acenaphthrene
See ACENAPHTHRENE COMPLEXES

Tetracyanoethylene Anthanthrene
See ANTHANTHRENE

Tetracyanoethylene-azulene
See AZULENE COMPLEXES

Tetracyanoethylene-hexamethylbenzene
See BENZENE COMPLEXES

Tetracyanoethylene Naphthalene
See NAPHTHALENE COMPLEXES

Tetracyanoethylene-pentamethylbenzene
See BENZENE COMPLEXES

Tetracyanoethylene-perylene
See PERYLENE COMPLEXES

Tetracyanoethylene-pyrene
See PYRENE COMPLEXES

TETRACYANOQUINODIMETHANE TCNQ

TETRAFLUOROETHYLENE-OXAZOLIDINONE-Na-DOPED

1, 4, 9, 10-Tetrahydroxyanthracene
See ANTHRACENE

Tetramethylbenzidine-nBr₂
See BENZIDINE COMPLEXES

Tetramethylbenzidine-nI₂
See BENZIDINE COMPLEXES

THIAZINE

THIOFLAVINE-S

THIOPHENE

THROMBIN

Thymus
See DNA

Thymus Nucleoprotein
See DNA

TOBACCO MOSAIC VIRUS

Trinitrophenol

See PICRIC ACID

TYROSIN

VICTORIA BLUE

VIOLANTHRENE

Violanthrene Bromine

See VIOLANTHRENE COMPLEXES

VIOLANTHRENE COMPLEXES

Violanthrene Iodine

See VIOLANTHRENE COMPLEXES

VIOLANTHRONE

Wheat Germ

See DNA

WOOL

XANTHANE

XANTHRENE

Xanthrene Triphenylmethane

See XANTHRENE

Yeast

See DNA