Rare-earth Information Center NEWS
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Atomic Form Factor Tables

A recent paper, "Detailed Tabulation of Atomic Form Factors, Photoelectric Absorption and Scattering Cross Section, and Mass Attenuation Coefficients in the Vicinity of Absorption Edges in the Soft X-ray (Z=30-36, Z=60-89, E=0.1keV), Addressing Convergence Issues of Earlier Work," by C. T. Chantler, was published in *J. Phys Chem. Ref. Data* **29** [4] 597 – 1048 (2000). Accurate values for the x-ray form factor and the photoelectric attenuation coefficient are necessary for many applications. Theoretical values currently used for these applications sometimes vary by as much as 200%. Much of this error is due to edge smoothing, nonrelativistic wave functions, and inappropriate convergence of wave functions. This work strives to reduce the errors present in these values.

The paper begins with an introduction that discusses the importance of form factors. Then the standard definitions of form factors are presented. Then a section expressing concerns over standard conventions appears, followed by sections with discussions on the reliability of experimental and theoretical results, issues that affect the determination of form factors, uncertainties near X-ray absorption edges and reasons for the new tabulation, and comparisons between earlier tabulations and the new tabulation. These are followed by instructions on how to use the tables and a summary of the uncertainties that remain in the new tabulation. All of this takes up a total of 20 pages. The remaining 452 pages contain the tables of data. Data for rare earth elements 60-71, Nd-Lu, are included in these tables.

Dr. Christopher T. Chantler is a Senior Lecturer in Physics at the University of Melbourne in Victoria, Australia. His research involves precision measurements of Quantum Electrodynamics in atomic systems, x-ray optics, and atomic physics. He has received several awards and honors. His research involves international collaborations and he has presented his work at multiple conferences.

For more information, Dr. Chantler can be reached at Optics Group, School of Physics (Room 505), University of Melbourne, Victoria, 3010, AUSTRALIA. Tel: +61 (0)3 8344 5437 (Office) or +61 (0)3 8344 0015 (X-ray Lab) Fax: +61 (0)3 9347 4783 Website: http://optics.ph.unimelb.edu.au/~chantler. ▲

HONOR ROLL

30 Years

Molycorp, Inc., USA (2000)
Santoku Corporation, Japan (2000)
Shin-Etsu Chemical Co., Ltd., Japan (2000)

20 Years

Shanghai Yue Long Non-Ferrous Metals Limited, China (2001)

10 Years

AMR Technologies, Inc., Canada (2000)
Dr. Peter Campbell, USA (2001)
Lynas Corporation, Ltd., Australia (2000)
Meldform Metals Ltd., England (2000)
Office of Atomic Energy for Peace, Thailand (2000)
Research Institute of Industrial Science and Technology, Korea (2001)

This year we would like to honor ten companies for their dedicated and lengthy support of the Rare-earth Information Center. We are honoring supporters who have reached the 10-, 20-, and 30-year milestones in either 2000 or 2001.

Last year we were delighted to double the number of our 30-year supporters. The honorees in this category include Molycorp, Inc., USA, Santoku Corporation, Japan, and Shin-Etsu Chemical Co., Ltd., Japan.

Shanghai Yue Long Non-Ferrous Metals Limited, China, has reached the illustrious 20-year milestone this year.

Our new 10-year supporters for last year included AMR Technologies, Inc., Canada, Lynas Corporation Ltd., Australia, Meldform Metals Ltd., England, and Office of Atomic Energy for Peace, Thailand. This year our 10-year honorees are Dr. Peter Campbell, USA, and Research Institute of Industrial Science and Technology, Korea.

Thank you to these ten companies for their long and continued support. We look forward to serving these and all our supporters for years to come. ▲

Crystal Structure Puzzle

A review by J. Hauck and K. Mika published in *Prog. Solid St. Chem.* **28** 1 – 200 (2000) goes a long way toward solving the puzzle of crystal structures. "The jig-saw puzzle of crystal structures: Alloys, superconducting oxides, semiconductors, ionic conductors, surface adsorbates and magnetic structures" gives the keys to understanding the crystal structures of many materials.

A lot of information is packed into this article. A thorough reading will give the reader a good understanding of materials structures. The primary emphasis on structural understanding is based on structure maps and self-coordination numbers of nearest and next-nearest neighbor relationships. The structures possible to be described based on these concepts also include magnetic structure and adatoms on a metal surface, and even segments of DNA.

To get an idea of the vast scope of this article, the sections of the text are as follows:

* Analysis of stacking sequences by the one-dimensional Ising model
* Alloy formation
* Ordering of atoms in hexagonal and square layers
* Hexagonal close-packed structures
* Cubic close-packed structures
* Ordered structures of complex close-packed alloys
* Structures with identical powder patterns
* Homologous series of structures
* Symmetry of ordered phases
* Ising model
* Characterization of structures by sequences of structural units
* Disordered alloys
* Ordered ternary and quaternary compounds
* Enhanced covalent bonding in layered compounds and ordered body-centered alloys
* Enhanced repulsive interactions
* Valence compounds
* Occupation of interstitial sites
* Bonding in interstitial alloys
* Magnetic interactions
* Ordering of I atoms on metal surfaces
* Related groups of structures
* Distorted structures
* Physical and chemical properties of structural units
* Homogeneous sphere packings and polymers
* Colloids, clusters and DNA
* Structure and interactions of atomic model
* Classification of symmetrical patterns

The paper is well thought-out, and figures and tables are used to help present data and concepts more clearly. In all, there are 46 figures and 25 tables, with some of each extending beyond one page in length. There are also 124 references cited for additional support for their arguments.

A list of notation symbols and two appendices round out the paper. Appendix A gives some basic structural information on the elements, such as ordering and coordination numbers, valence electrons, electronegativity, and pseudopotential radii. Appendix B is a list of reduced unit cells, self-coordination numbers, cell parameters, and other structural information for compounds grouped by compound type.

For more information on this topic, contact J. Hauck or K. Mika at the Institut fur Festkorperforschung, Forschungszentrum Julich, Julich, Germany, Tel: 49 (0) 2461 614237 (J. Hauck) or 616449 (K. Mika), Fax: 49 (0)2461 612280, e-mail: j.hauck@fz-juelich.de or k.mika@fz-juelich.de. ▲

Conference Calendar

Note: Reach as many potential conference attendees as possible! Send us your conference announcement and we will publish it here.

June '01
The 4th International Conference on Rare Earth Development & Applications (ICRE-2001)
Beijing, China
June 15-20, 2001
RIC News **XXXV**, [2] 6 (2000)

July '01
International Conference on Dynamical Processes in Excited States of Solids (DPC'01)
Lyon, France
July 1-4, 2001
RIC News **XXXV**, [3] 3 (2000)

August '01
Joint European Magnetic Symposia EMMA-MRM (JEMS'01)
Grenoble, France
August 28-September 1, 2001
RIC News **XXXVI**, [1] 4 (2001)

September '01
Rare Earths' - 2001
São Paulo - SP, Brazil
September 22-26, 2001
Website: http://www.iq.usp.br/geral/congress.html.
RIC News **XXXIII**, [4] 3 (1998)

November '01
46th Conference of Magnetism and Magnetic Materials (MMM01)
Seattle, Washington, USA
November 12-16, 2001
e-mail: magnetism@courtesyassoc.com

July '02
The 23rd Rare Earth Research Conference
Davis, California, USA
July 13-18, 2002
RIC News **XXXV**, [2] 4 (2000)

August '02
17th Int. Workshop on Rare-Earth Magnets and their Applications
Newark, Delaware, USA
August 19-22, 2002
RIC News **XXXV**, [4] 3 (2000)

July '03
International Conference on Magnetism (ICM'2003)
Rome, Italy
July 27-August 1, 2003
RIC News **XXXVI**, [1] 4 (2001)

(Pr-Nd-Ce)FeB Magnets for MRI

MRI medical imaging structures use several metric tons of permanent magnet, and MRI techniques require maximum energy products around 40 to 45 MGOe. To satisfy both of these requirements and reduce the cost of the permanent magnet material, innovations in material composition and production were presented in a paper at the *16th International Workshop on Rare-Earth Magnets and Their Applications*, September 2000. The paper, entitled "High-energy-product (Pr-Nd-Ce)FeB magnets produced directly from mixed-rare-earth-oxide feed for MRI medical imaging applications," is published in the proceedings of the conference, volume 1, page 99-108.

Permanent magnet MRI systems account for about 10% of all MRI systems installed throughout the world, and their market share is increasing. Further reducing the manufacturing cost of the rare-earth permanent magnet would help this market share grow even faster. Two innovations are proposed to meet this end: changing the rare-earth composition to maximize use of the rare-earths present in the as-mined ore, and developing a new separation and reduction process to produce the desired composition at minimum cost. Both innovations are explored and presented in the paper.

The two innovations are not exclusive in nature, in fact, they complement each other well. Through considerations of the processing, possible compositions are derived. These compositions are then studied to see which has the desired properties (i.e., high energy product). The results presented in this article are a composition of less than 10at% Ce, with the best results (highest coercivity) attained with less than 5at% Ce. The final composition after separation was a mixed oxide of 71%Pr, 27%Nd, and 2%Ce. This oxide mix was used to make $(Pr_{.71}Nd_{.27}Ce_{.02})FeB$ magnets. After processing the magnet material, the maximum energy product varied from 39.85 to 45.12 MGOe. Therefore, the processes outlined in the paper should make materials well suited for MRI techniques. ▲

Comments or suggestions? Send them to ric@ameslab.gov. ▲

CMR Materials

Elbio Dagotto, Takashi Hotta and Adriana Moreo have written a review, "Colossal magnetoresistant materials: the key role of phase separation," that was published in *Phys. Rpts.* **344** 1 – 153 (2001). This is an extensive and detailed review of magnetoresistant materials.

The review emphasizes theoretical work on these materials, as other reviews have focused more on experiments. The materials discussed include $(La,Sr)MnO_3$, $(La,Ca)MnO_3$, and $(Pr,Ca)MnO_3$. Stabilization of charge/spin/orbital phases, phase separation, and the intrinsic inhomogeneities of manganites are among the main points of the paper.

After the excellent introduction to the paper and before the conclusion are included three main sections. The first of these sections addresses the basic properties, phase diagrams, and the colossal magnetoresistance effect in manganites. Specific properties addressed include resistance (of course), magnetic phase diagrams, charge and orbital ordering configurations, and crystal structures. The materials are treated according to bandwidth size, grouping them into large, intermediate, and small bandwidths. The three bandwidth divisions are a departure from the normal treatment of manganites, which groups the materials into large and small bandwidth divisions.

The second major section addresses the theory of manganites. First a little history is given, and covers the double-exchange model and an approach put forward by Goodenough, where covalent bonds are important, and an approach based on using the Mn atoms only for the model Hamiltonian. This last approach leads to the ferromagnetic interaction as purely a consequence of Hund coupling in the system. Next follows a discussion of more recent theories, including that double exchange is insufficient to adequately define the proper Curie temperature and the need for considering Jahn-Teller phonons and polarons. Then comes a detailed discussion of models and parameters. Included are crystal field effects, Coulomb interactions, electron-phonon coupling, hopping amplitudes, and the description of a full Hamiltonian and how parts of the Hamiltonian are used for different models. Clues to calculating the terms of the Hamiltonian are also given. Following this are more detailed discussions on one- and two-orbital models, mixed-phase states, and phase separation.

The third major section gives details on how experimental data fit the models described in the previous section. The information in this section is grouped by material and concentration. Discussions also include mixed-phases in bi-layered and single-layered manganites and possible mixed-phase tendencies in nonmanganites. The nonmanganites mentioned include $(La,Y)TiO_3$, Gd_2PdSi_3, $(La,Sr)CoO_3$, $(Tl,Sc)Mn_2O_7$ and $(Se,Te)CuO_3$, among others.

The discussion and conclusions section restates the positions expressed in the paper, presenting an excellent summary. There are also some points for future study mentioned. Overall, this work shows the great complexity of the problem of describing colossal magnetoresistance, and it does a very good job showing the way to a solution. The claims of the paper are supported by 447 references, 112 equations, 86 figures, and 2 tables.

For more information on this subject, Elbio Dagotto can be contacted at Fax: 1 850 644 5038, e-mail: dagotto@magnet.fsu.edu. ▲

Magnequench Patent Infringement Suits

Magnequench International, Inc., has filed patent infringement lawsuits against 10 electronic and computer firms for infringement of four of its patents. Magnequench holds patents and is a world leader in the manufacture of specialized Nd-Fe-B magnetic powders and magnets. These materials are used in Cd and DVD-ROM drive spindle motors in computers, in home entertainment systems, and in the motors that operate zoom lenses of camcorders. Magnequench has proof from an independent testing laboratory that the magnetic material used in the products of the companies under suit violate Magnequench's patents. ▲

News from Japan

Our thanks as always to Kensuke Shimomura for the content and translations for this section.

The Kobe Shimbun, 14 Feb. 2001: Santoku Corp. will set up a joint company in China to manufacture and sell mischmetal and hydrogen-storage alloys for NiMH batteries. Baotou Santoku Battery Materials Co., Ltd. (BSBM) will be set up with financial capital from Santoku Corp., Rhodia, Baotou Rare Earth New Technology Development Zone, and West Lake. BSBM will supply its products to local battery makers, with exports to Asia and Japan planned for the future.

The Japan Times, 20 Feb. 2001: NKK Corp. and Siemens Westinghouse Power Corp. have joined forces to sell solid oxide fuel cells and offer after-sale services. NKK will begin selling test products in Japan and Asia by the end of 2003.

The Nikkei Weekly, 19 Feb. 2001: DaimlerChrysler and Mazda Motor Corp. have begun road tests on prototype vehicles using fuel cell power sources. DaimlerChrysler plans to have fuel cell buses in Europe in 2002 and passenger cars available by 2004. Japan's Ministry of Economy, Trade, and Industry projects that 50,000 fuel-cell vehicles will be on the road in Japan by 2010.

The Nikkan Kogyo Shimbun, 22 Feb. 2001: Cataler Corp. will be supplying automotive catalysts to General Motors Corp. Cataler developed a new type of catalyst with better heat resistance and lower cost than the products GM is currently using. In response to the order for one million units, Cataler expects to build a new plant near the East Coast of the United States, which will be completed by 2003.

The Nikkei Sangyo Shimbun, 22 Feb. 2001: Tosoh Corp. plans to double its zirconia powder production. Tosoh's zirconia powders are used in fiber optic connectors, and the company currently holds a 60% share of the world market for these powders.

The Nikkan Kogyo Shimbun, 28 Feb. 2001: Sumitomo Osaka Cement Co. plans to triple its zirconia powder production. The plant in Kaizuka will be expanded to meet this production goal. Their powders are used for connections in fiber optics.

The Nihon Keizai Shimbun, 28 Feb. 2001: Toyota has developed a new type of fuel-cell hybrid vehicle, FCHV-3, which uses polymer electrolyte fuel cells and NiMH batteries. The prototype was unveiled at the *13th International Symposium on Fuel Cell Vehicles* in Tokyo, held on March 1-2 2001. The new vehicle has a maximum speed of 150 km/h and a cruising distance of over 300 km. Road tests are expected to begin this summer, with commercial models available by 2003.

The Nikkan Kogyo Shimbun, 2 Mar. 2001: Sanyo Electric Co. is preparing for mass production of NiMH batteries for use in hybrid electric vehicles. The Tokonabe plant in Kasai City, Hyogo Prefecture, is being developed as a production base of HEV Integrated Starter-Generator systems. Sanyo will supply battery systems for Ford Motor Co.'s first HEV, which is expected to be available in 2003. Sanyo is trying to develop their products to be competitive in the market currently dominated by Toyota-Matsushita products.

The Nihon Kogyo Shimbun, 6 Mar. 2001: Cataler Corp. will build a new auto catalyst plant in Lincoln, North Carolina, to meet globally rising demand. The plant is expected to begin production in October 2002.

The Rare Metal News, 15 Mar. 2001: Japanese production of NiMH batteries for 2000 has increased 18% over 1999 output levels, with the value of these batteries increasing 9%.

The Nikkei Weekly, 26 Mar. 2001: Toshiba Corp. is ceasing production of cathode ray TV sets in Japan, and will move its production of TVs to China. This move will take advantage of lower labor costs in China.

The Nihon Keizai Shimbun, 4 Apr. 2001: Panasonic EV Energy Co., a joint venture of Toyota Motor Corp. and Matsushita Electric Industrial Co. group, plans to increase production of NiMH battery systems for hybrid cars by 25% over year 2000 levels.

The Nihon Keizai Shimbun, 5 Apr. 2001: Aichi Steel has begun mass production of Nd-Fe-B anisotropic bonded magnetic powder. Annual production has started at 600 tons with plans to increase to 3000 tons by 2003.

Toyota Motor Corp press release, 11 Apr. 2001: 300 Toyota Prius hybrid-electric cars will be sold to New York City area entities. New York City will buy 231 for a variety of municipal agencies, New York's MTA NYC Transit will buy 56 for road control, route planning, and other support operations, and the State of New Jersey will buy 33 for the State Central Motor Pool and the Port Authority. The Toyota Prius' low emissions and high gas mileage make it especially suited for urban use.

North American Minerals News, May 2001: Altair Technologies Inc. has developed a process to produce commercial quantities of nano-sized YSZ. The nano-sized YSZ will improve thermal spray products used for corrosion protections, thermal barriers, and microformed products.

The Japan Times, 11 May 2001: A 'Green' car panel was recently formed in Japan, with the intention of promoting environmentally friendly vehicles. It is making plans to replace all state-owned vehicles with low-emission vehicles, such as hybrid cars, by the end of fiscal 2004.

The Nikkei Sangyo Shimbun, 15 May 2001: NGK Spark Plug Co. has developed 3 types of sensors for possible use in fuel-cell powered cars. The three sensors, each the first of its kind, are based on the technology for zirconia-based oxygen sensors, and include a hydrogen sensor, a hydrogen flow sensor, and a hydrogen sensor for leak monitoring. NGK plans to commercialize a product that will be practical for use with fuel-cell cars.

The Nihon Keizai Shimbun, 18 May 2001: Rare earth imports to Japan from China have experienced a price decrease of 20 to 40% since the end of last year. Reasons for the price decline include production adjustments due to inventory concerns in the areas of personal computers and cellular phones. ▲

Baotou Santoku Battery Materials Co.

A Joint Venture Agreement has been signed between Santoku Corporation, Rhodia, Baotou Rare Earth New Technology Development Zone (BRDZ), and West Lake.

Baotou Santoku Battery Materials Co. Ltd. (BSBM), will have its head office in Baotou, Inner Mongolia, China. Santoku will contribute 70% of the registered capital, and the remaining 30% will be contributed by Rhodia, BRDZ, and West Lake.

The Chairman of the Board and the General Manager of the new company will be delegated by Santoku Corporation. BSBM will manufacture mischmetal and Ni-MH alloys for batteries and sales activities under Santoku Corporation management in China. Operations will begin once the business license is issued. BSBM will supply products to companies in China and other Asian countries.

The formation of BSBM is advantageous to Santoku Corporation as it will provide a stable and inexpensive means for procurement of raw materials and it will strategic for expanding operations in China to address the growing demand for mobile phone batteries. ▲

Correction and Addendum

In the March issue of the *RIC News* **XXXVI** [1] 5 (2001), Wheeler Associates Permanent Magnet Consultants was listed in our Consultant's Corner. Unfortunately, the phone number listed is incorrect. The correct phone number is 270-765-6773. We apologize for any inconvenience this error may have caused.

In addendum to the listing mentioned above, Mr. Port Wheeler has 30 years experience as a Consultant in addition to his 20 years in Senior Management positions. ▲

Newsletter on the Web

A paperless alternative to receiving an electronic form of the *RIC News* via e-mail is to access our website: http://www.ameslab.gov/ric, where current and previous issues of the *RIC News* are available. ▲

Consultant's Corner

To appear in our Consultant's Corner, any individual, company, or group must be involved in rare earth or rare-earth-related consulting activities. Just send us the appropriate information: contact name, company name, mailing address, Tel/Fax number(s), e-mail, web address, and areas of expertise.

WebMagnetics, Inc.-Bob Zoglmann, President-Professional Services Group.
P.O. Box 1448, Elizabethtown, KY 42702-1448. Telephone: 270-737-0160; Fax 270-737-0203; e-mail: zoglmann@webmagnetics.com. ▲ Areas of expertise: Professional services for the international permanent magnet industry and markets. Mr. Zoglmann has over 25 years experience in senior management positions in the permanent magnet industry. WebMagnetics is a vertical trade community serving the Magnetics Industry, having a network of international industry experts with specialties in all aspects of the permanent magnet business. See web site: www.webmagnetics.com for more details.

Permanent Magnets

For those just getting started in permanent magnets, or for anyone interested in how the study of permanent magnets has progressed, a recent review article provides an excellent introduction. The review, "High-performance permanent magnets," was written by D. Goll and H. Kronmuller and published in *Naturwissenschaften* **87** 423 – 438 (2000).

The introduction offers an excellent overview of magnetism, explaining and illustrating basic magnetic concepts, mentioning several materials systems used in permanent magnets and what properties they posses that make them good permanent magnets, and listing several common and a few less-common applications for permanent magnet materials.

The remainder of the article is divided into three segments. The first focuses on permanent magnet materials. The two focused on in this paper are $RE_2Fe_{14}B$, with RE = Nd or Pr, and $Sm_2(Co,Cu,Fe,Zr)_{17}$. A history of the development of materials illustrating the decreasing volume of material required for the same magnetic strength is presented, as well as a unit cell of $RE_2Fe_{14}B$ and discussions of selection criteria, world markets, what causes large coercive fields, and materials preparation methods.

The second section strives to definitively link microstructure with magnetic properties. It includes some nice figures including micrographs, composition profiles, hysteresis curves, a phase diagram, and microstructure sketches, and discussions of how these are related. The section is grouped by microstructure feature size, with microcrystalline permanent magnet subsections including RE-Fe-B, $Sm_2(Co,Cu,Fe,Zr)_{17}$, and nanocrystalline permanent magnets covering decoupled magnets, stoichiometric single-phase magnets, and composite two-phase magnets.

The discussions in the second section help draw correlations between microstructure and magnetism, but the quantitative analytical proof can be complicated. The third section addresses this problem, and is devoted to computer simulations that quantitatively show the correlation between microstructure and magnetism.

The claims of the paper are supported by 60 references, and there are a total of 13 figures, several of which have multiple parts. For more information about this paper or about permanent magnets, contact D. Goll, Max-Planck-Institut fur Metallforschung, Heisenbergstrasse 1, 70569 Stuttgart, Germany, e-mail: goll@vaxph.mpi-stuttgart.mpg.de, Tel: 49-711-6891814. ▲

Rare Earth Handbook, Volumes 27, 28, and 29

We have recently received volume 27, 28, and 29 of the *Handbook on the Physics and Chemistry of Rare Earths*, edited by K. A. Gschneidner, Jr. and L. Eyring. These three volumes provide a great deal of useful information for several different areas of rare earth inquiry.

Volume 27, published as the last volume of the 1900s, contains three articles on intermetallic compounds. The first article, Chapter 173, is by P. S. Salamakha, O. L. Sologub, and O. I. Bodak and is called "Ternary rare-earth-germanium systems." At 223 pages, it is a massive compilation of phase diagrams and structure information on R-M-Ge ternary metallic systems. The 314 composition systems covered, the discussions of peculiarities in some systems, and the 257 references should provide information for anyone interested in ternary rare earth-germanide systems. The second article, Chapter 174, "Crystal structures and crystal chemistry of ternary rare-earth germanides," is by P. S. Salamakha. This 114-page article includes structural information, including atomic coordinates, crystal projections and coordination polyhedra, and comments and discussion for many of the compounds mentioned in the first article. The third article, chapter 175, is by Bogdan Ya. Kotur and Ernst Gratz. "Scandium alloy systems and intermetallics" includes phase diagram and structural information for many binary and ternary scandium alloy compositions. This article is 193 pages long and includes 525 references. The three articles together are an excellent reference for structural information and would be useful for people investigating those materials.

Volume 28, the first volume of the 2000s, sets out to help explain some of the mysteries associated with rare earths. Chapter 176, "Electron excitation in atomic species," is by J. -P. Connerade and R. C. Karnatak. This article discusses the physics of orbital collapse, using a double-well potential concept. Chapter 177 is "Simple and complex halides," by Gerd Meyer and Mathias S. Wickleder. This chapter presents structural and synthesis information for the rare earth halides, grouped by complexity of the compound. "Solid electrolytes," Chapter 178, is by R. Vasant Kumar and Hiroyasu Iwahara. It presents that conduction character and applications of several different types of solid electrolytes. A Halperin is the author of "Activated thermoluminescence (TL) dosimeters and related radiation detectors," which is Chapter 179. This article covers the theory of thermoluminescence and how thermoluminescence is used in dosimetry. Then several r-activated thermoluminescence dosimeters and their characteristics are presented. According to the editors, Chapter 179 is a selective review, based on areas of the most progress. "Analytical separations of the lanthanides: basic chemistry and methods" is Chapter 180. Several separation methods are discussed, along with the fundamental chemistry that is the basis for separation. Some applications are also presented.

Volume 29 is subtitled "The Role of Rare Earths in Catalysis." It contains six chapters, which are as follows: Chapter 181: "The metals and alloys in catalysis," by V. Paul-Boncour, L. Hilaire, and A. Percheron-Guegan. Chapter 182: "The metals and alloys (prepared utilizing liquid ammonia solution) in catalysis II," by Hayao Imamura. Chapter 183: "The mixed oxides," by M. A. Ulla and E. A. Lombardo. Chapter 184: "Ceria-containing three-way catalysts," by Jan Kaspar, Mauro Graziani, and Paolo Fornasiero. Chapter 185: "The use of rare-earth-containing zeolite catalysts," by A. Corma and J. M. Lopez Nieto. Chapter 186: "Triflates," by Shu Kobayashi. A Foreword by Patrick Maestro begins Volume 29 off by giving a historical overview of rare earths in catalysis, a look at the new uses for rare earth catalysts, and a glimpse into the future of rare earth catalysts.

These three volumes are welcome additions to the *Handbook on the Physics and Chemistry of Rare Earths* series, and should prove useful tools for many researchers involved with rare earth materials. These books are available from Elsevier Science, P. O. Box 211, 1000 AE Amsterdam, The Netherlands, Tel: 31 20 485 2603, Fax: 31 20 485 3533. In the USA/ Canada: Elsevier Science Inc., P. O. Box 945, Madison Square Station, New York, NY 10160-0757, U.S.A. ▲

The Current State of Superconductivity

E. G. Maksimov has written a review, "High-temperature superconductivity: the current state," that was published in *Physics – Uspekhi* **43** [10] 965 – 990 (2000). The review is a fairly detailed treatment of superconductivity theory and provides an interesting perspective on models and theories widely quoted in research papers on the topic.

The first section of the paper is called "Introduction and a few words about myths." Just by reading this heading one knows a thought-provoking discussion is about to ensue. Maksimov divides the work on superconductivity into two stages, which he calls the prehistoric and the historic, with the historic stage beginning with the experimental observation of superconductivity in $La_{2-x}Ba_xCuO_4$. The first myth about high-temperature superconductivity (HTSC) was when the HTSC problem was compared with a UFO, thus making the problem itself seem a myth. Another myth was a limitation on the increase of T_c put forward by a pair of researchers in 1972. A third myth involves the Landau Fermi-liquid theory, as many theoretical and experimental papers mention that the electron systems in HTSC cuprates exhibit non-Fermi-liquid behavior. Maksimov continues with a discussion on why no sweeping conclusion to that effect can be made.

The second major section of the article focuses on what makes a conventional metal. The discussion includes Fermi liquid theory, electron-phonon interaction calculations, Frolich Hamiltonian, transport, density of states, band theory, Green's functions, and comparisons between theoretical values and experimental observations.

The third section is "How far are superconducting cuprates from 'conventional' metals?" The focus of this section is on optimally doped cuprate superconductors. These systems are considered unconventional metals, and over- and under-doped superconductors stray even further from "conventional" metals. The discussion is in-depth

Continued on page 7

Continued from page 6

and covers many electronic properties of the materials, including band structure, transport, energy loss, reflection coefficients, and Fermi surfaces. One of the conclusions reached is that in some respects, superconducting cuprates are not really all that different from "conventional" metals.

The fourth section is "The enigma of the superconducting state in cuprates." The primary argument presented is that the electron-phonon interaction exists in the superconducting state of cuprate superconductors. However, the electron-phonon interaction cannot explain the high anisotropy of the energy gap, nor can it explain the high $2\Delta/T_c$ ratios.

The review is an in-depth look at the state of superconductivity as it is understood today. Many arguments are made in a small space, without sounding simply like a litany of data. Maksimov's own opinions on the results of his colleagues and peers in superconductor research are loud and clear. The paper contains 119 equations and 19 figures to illustrate his arguments.

For more information, E. C. Maksimov can be contacted at the P. N. Lebedev Physics Institute, Russian Academy of Sciences, Leninskii Prop. 53, 117924 Moscow, Russian Federation, Tel: (7-062) 135-7511, Fax: (7-095) 135-8533, e-mail: maksimov@lpi.ru. ▲

E-Mail Subscription

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Search of the Month

Ric Database Report

keywords colossal ***AND*** ***keywords*** magnetoresist ***AND*** ***keywords*** 2000 ***AND*** ***keywords*** (La,Ca)MnO3

Document Number ***Article***

200001260 Breakdown of the lattice polaron picture in La0.7Ca0.3MnO3 single crystals
CHUN;SH SALAMON;MB TOMIOKA;Y TOKURA;Y
Phys. Rev. B, 61, [14], R9225-R9228 (2000)
(La,Ca)MnO3 2000 activation-e colossal Curie-temp ferromag Hall-const Hall-effect Hall-mobility Hall-reisit magnetization magnetoresist metallic polaron resistivity

200001280 Temperature dependent changes of the Mn 3d and 4p bands near T(c) in colossal magnetoresistance systems: XANES study of La(1-x)Ca(x)MnO3
BRIDGES;F BOOTH;CH KWEI;GH NEUMEIER;JJ SAWATZKY;GA
Phys. Rev. B, 61, [14], R9237-40 (2000)
(La,Ca)MnO3 2000 colossal correlat-funct coupling Hunds-rule hybrid-orbital hybridization K-absorp-edge LaMNO3 LSDA magnetoresist temp-dependenc XANES

200001550 Magnetic transitions in thin films of La0.67Ca0.33MnO3 and Pr0.65Ca0.35MnO3
YANAGISAWA;O IZUMI;M HUANG;K-H HU;W-Z SHEN;Y NAKANISHI;K TAKAHASHI;Y NOJIMA;H
J. Magn. Magn. Mater., 211, 254-8 (2000)
(La,Ca)MnO3 (Pr,Ca)MnO3 2000 colossal Curie-temp DC electron-spin EPR mag-ordering mag-transition magnetoresist metinsulat-tr oxide phase-transiti resistivity resonance resonance-fld temp-dependenc thin-film x-ray-diffract

Thursday, May 24, 2001 ***Page 1 of 1***

The search above satisfies a search for information on colossal magnetoresistance in $(La,Ca)MnO_3$ contained in papers published in 2000 (colossal AND magnetoresist AND $(La,Ca)MnO_3$ AND 2000). Many more citations would have been referenced if other compounds or years were included in the search.

The database report, as shown above, which is provided when the search is purchased, includes the keywords used for the search and the bibliographical information of the reference, along with other keywords associated with the reference, for each of the references found. A preliminary search, often sent as an evaluative tool for the requestor, will list titles and keywords of the items that match the request.

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Lanthanide Organometallics

A recent review on lanthanide organometallics appeared in *Russ. Chem. Rev.* **69** [9] 783 – 794 (2000). The 12-page article, "Arene complexes of rare-earth metals," by M. N. Bochkarev, contains a great deal of information on organometallic compounds containing rare-earth metals.

The review addresses the synthesis, structure, bonding character, reactivity, and catalytic activity of five different groups of organometallic complexes. The complexes addressed all contain rare-earth metals, p-bonded ligands, and one or more 6-membered aromatic rings.

The five complex groups include derivatives of benzene and it homologues, naphthalene derivatives, anthracene, pyrene and benzoanthracene derivatives, and heterocyclic aromatic ligands. Each section includes discussions on interaction between the lanthanide metal and the rest of the organometallic complex, bond lengths and interatomic distances, and the strength and nature of the p-bonds. Each section also shows diagrams of the atomic structures of some of the complexes presented.

A section on the reactivity of arene lanthanide complexes follows. This section contains some general comments of chemical properties, the ease of preparation of the materials, a table of naphthalene complex reactions, and a table of the reactions of naphthalene mixed-ligand lanthanide complexes.

While the review itself is relatively concise, there is an extensive bibliography, containing 107 items, that accompanies the paper. Also included throughout the paper are 34 chemical structure figures and 11 additional chemical reactions.

M. N. Bochkarev can be contacted at the G. A. Razuvaev Institute of Organometallic Chemistry, Russian Academy of Sciences, ul. Tropinina 49, 603600 Nizhnii Novgorod, Russian Federation. Fax: (7-831) 266 14 97, Tel.: (7-831) 266 67 95, e-mail: mboch@imoc.sinn.ru. ▲

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Since the June issue of the RIC News, we have received support from three new family members and renewed support from 18 other organizations and individuals.

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