Rare Earth Elements A New Approach To The Nexus Of Supply Demand And Use Exemplified Along The Use Of Neodymium In Permanent Magnets Springer Theses

The rare earths have a unique place among the elements. Although very much alike chemically and in most phy~ical properties they each have very different and striking magnetic properties. The reason, of course, lies in their 4f electrons which determine the magnetic properties but have little effect on other chemical and physical behaviour. Although they are not rare, some indeed are among the more common heavy elements in the earth's crust, the difficulty of separation has meant that their intricate magnetic properties have only recently been unravelled. Now, however, the general pattern of their magnetism is well charted and the underlying theory is well understood. Both are thoroughly summarised in this book. It provides an excellent example of the kind of extensive synthesis which is possible with modem solid state physics. it represents only a high plateau in the ascent to complete understanding. But It will become clear to the reader that while the overall position is satisfactory there are many details still to be elucidated experimentally and much to be done theoretically before all the underlying forces are identified and estimated from a priori calculations. It is hoped that the book will provide a useful stimulus in this direction. It should also be of use to those who are interested in related disciplines, for example the rare earth compounds, or the transition metals. In addition rare earths promise to be important technologically as alloy constituents.

This book (Special Issue) presents the geological environment, physical/chemical properties, and crystallographic data for two new minerals associated with chromitites from the Othrys ophiolite complex: Eliopoulosite, V7S8/IMA2019-96, and Grammatikopoulosite, NiVP/IMA2019-090. The distribution, mineralogy, and field relationships of PGE-enriched ores, which are important for our understanding of the metallogenic controls on the concentration of PGE and their exploration, are addressed in papers, providing (a) the first detailed data on the chromitites and platinum-group elements (PGE) mineralization from Ulan-Sar'dag ophiolite, Central Asian Fold Belt/East Sayan, Russia, (b) peculiarities on the distribution of PGE in arsenopyrites and pyrites from the Natalkinskoe gold ore deposit, NE Russia, and (c) the occurrence of zoned laurite found in the Merensky Reef of the Bushveld layered intrusion, South Africa, characterized by textural/compositional features suggesting "hydrothermal" origin. Two papers deal with (a) the rare earth element (REE) distribution in various mineral deposits of Sweden, obtained during the EURARE project, and their application to the exploration of REE and (b) the optimization of the beneficiation process for the REE recovery from black sands. Five papers provide new data of genetic and exploration significance on trace elements, including REE and PGE in various ore-types, and factors controlling the Cr stable isotope (?53Cr values) in chromitites from the Balkan peninsula.

Optical spectroscopy has been instrumental in the discovery of many lanthanide elements. In return, these elements have always played a prominent role in lighting devices and light conversion technologies (Auer mantles, incandescent lamps, lasers, cathode-ray and plasma displays). They are also presently used in highly sensitive luminescent bio-analyses and cell imaging. This volume of the Handbook on the Physics and Chemistry of Rare Earths is entirely devoted to the photophysical properties of these elements. It is dedicated to the late Professor William T (Bill) Carnall who has pioneered the understanding of lanthanide spectra in the 1960's and starts with a Dedication to this scientist. The following five chapters describe various aspects of lanthanide spectroscopy and its applications. Chapters 231 presents state-of-the-art theoretical calculations of lanthanide energy levels and transition intensities. It is followed by a review (Chapter 232) on both theoretical and experimental aspects of f-d transitions, a less well known field of lanthanide spectroscopy, yet very important for the design of new optical materials. Chapter 233 describes how confinement effects act on the photophysical properties of lanthanides when they are inserted into nanomaterials, including nanoparticles, nanosheets, nanowires, nanotubes, insulating and semiconductor nanocrystals. The use of lanthanide chelates for biomedical analyses is presented in Chapter 234; long lifetimes of the excited states of lanthanide ions allow the use of time-resolved spectroscopy, which leads to highly sensitive analyses devoid of background effect from the autofluorescence of the samples. The last review (Chapter 235) provides a comprehensive survey of near-infrared (NIR) emitting molecular probes and devices, spanning an all range of compounds, from simple chelates to macrocyclic complexes, heterometallic functional edifices, coordination polymers and other extended structures. Applications ranging from telecommunications to light-emitting diodes and biomedical analyses are assessed. - Provides a comprehensive look at optical spectroscopy and its applications - A volume in the continuing authoritative series which deals with the chemistry, materials science, physics

and technology of the rare earth elements
This book deals with Rare Earth Elements, applying basic research data on neodymium used in permanent magnets. Surprisingly, analysis showed that hard drives, mobile phones, wind turbines and e-mobility account for much less use of neodymium than supposed.
The continuously increasing demand for rare earth elements in technical components of modern technologies, brings the detection of new deposits closer into the focus of global exploration. One promising method to globally map important deposits might be remote sensing, since it has been used for a wide range of mineral mapping in the past. This doctoral thesis investigates the capacity of hyperspectral remote sensing for the detection of rare earth element deposits. The definition and the realization of a fundamental database on the spectral characteristics of rare earth oxides, rare earth metals and rare earth element bearing materials formed the basis of this thesis. To investigate these characteristics in the field, hyperspectral images of four outcrops in Fen Complex, Norway, were collected in the near-field. A new methodology (named REEMAP) was developed to delineate rare earth element enriched zones. The main steps of REEMAP are: 1) multitemporal weighted averaging of multiple images covering the sample area; 2) sharpening the rare earth related signals using a Gaussian high pass deconvolution technique that is calibrated on the standard deviation of a Gaussian-bell shaped curve that represents by the full width of half maxima of the target absorption band; 3) mathematical modeling of the target absorption band and highlighting of rare earth elements. REEMAP was further adapted to different hyperspectral sensors (EO-1 Hyperion and EnMAP) and a new test site (Lofdal, Namibia). Additionally, the hyperspectral signatures of associated minerals were investigated to serve as proxy for the host rocks. Finally, the capacity and

limitations of spectroscopic rare earth element detection approaches in general and of the REEMAP approach specifically were investigated and discussed. One result of this doctoral thesis is that eight rare earth oxides show robust absorption bands and, therefore, can be used for hyperspectral detection methods. Additionally, the spectral signatures of iron oxides, iron-bearing sulfates, calcite and kaolinite can be used to detect metasomatic alteration zones and highlight the ore zone. One of the key results of this doctoral work is the developed REEMAP approach, which can be applied from near-field to space. The REEMAP approach enables rare earth element mapping especially for noisy images. Limiting factors are a low signal to noise ratio, a reduced spectral resolution, overlaying materials, atmospheric absorption residuals and non-optimal illumination conditions. Another key result of this doctoral thesis is the finding that the future hyperspectral EnMAP satellite (with its currently published specifications, June 2015) will be theoretically capable to detect absorption bands of erbium, dysprosium, holmium, neodymium and europium, thulium and samarium. This thesis presents a new methodology REEMAP that enables a spatially wide and rapid hyperspectral detection of rare earth elements in order to meet the demand for fast, extensive and efficient rare earth exploration (from near-field to space).

This book examines the development, use, extraction, and recovery of rare earth metals. Rare earth elements (REEs) occupy a key role in daily life in industrial applications. They are one of the critical elements for energy and sustainable growth. REEs are utilized in many modern electrical and electronic devices such as smart phones, computers, LED lights etc. Recovery of the REEs from secondary resources represents a way to meet the growing demand for electronic devices. Because of their rarity, utility, and importance, the recovery, utilization and recycling of rare earth metals is of utmost importance. This book presents both current methods of processing rare earths from primary and secondary sources and new, green routes for their isolation and purification. The book also addresses their utilization, re-use, reduction, and recycling policies that exist globally. Applications in metallurgy, magnets, ceramics, electronics, and chemical, optical, and nuclear technologies are discussed.

This book is aimed to compile the distribution of rare earth elements in various resources with their processing from secondary resources. It includes details of various processes developed for extraction of rare earth elements from varied raw materials ranging from e-wastes, tailings, process wastes and residues. It emphasizes importance of processing of the secondary resources to assist environmental remediation of such untreated wastes and get finished products. It covers all aspects of rare metals and rare earth metals in one volume covering extraction, separation and recycling of secondary resources for extraction of these metals along with relevant case studies.

Rare Earth Elements are a group of 17 metals which have a central role in modern industry, increasingly used in the fields of green technologies, high technological consumer goods, industrial and medical appliances and modern weapons systems. Although deposits of Rare Earths are globally dispersed, over 90% of global demand has been provided by Chinese mines since the late 1990s, leading to a situation where China has a virtual monopoly. This book surveys the Rare Earths mining industry, discusses the extent to which Rare Earths really are scarce elsewhere in the world and assesses the economics of production, considering arguments for the rationing of supply, for higher pricing and for a total export embargo. This actually occurred in 2010,

demonstrating the vulnerability of the rest of the world to China's control of these increasingly vital resources.
This book describes the properties, characteristics, and uses of rare earth elements. It explains where, in what quantities, and how these elements occur in nature, as well as how they are processed from ores into marketable end materials. Retaining its status as a comprehensive monograph for academic, industry, and regulatory professionals, the Second Edition includes a new chapter on the recycling of rare earth elements from devices such as unused batteries and electronics, and is updated throughout with important developments from the past ten years.
"China controls approximately 97 percent of the world's rare earth element market. These elements, which are not widely known because they are so low on the production chain, are critical to hundreds of high tech applications, many of which define our modern way of life. Without rare earth elements, much of the world's modern technology would be vastly different and many applications would not be possible. For one thing, we would not have the advantage of smaller sized technology, such as the cell phone and laptop computer, without the use of rare earth elements. Rare earth elements are also essential for the defense industry and are found in cruise missiles, precision guided munitions, radar systems and reactive armor. They are also key to the emergence of green technology such as the new generation of wind powered turbines and plug-in hybrid vehicles, as well as to oil refineries, where they act as a catalyst. (Note: for more in-depth information on the specific uses of rare earth elements, refer to Appendix A). Over the past few years, China has come under increasing scrutiny and criticism over its monopoly of the rare earth industry and for gradually reducing export quotas of these resources. However, China is faced with its own internal issues that, if not addressed, could soon

stress the country's rare earth industry. This paper is designed to give the reader a better understanding of what rare earth elements are and their importance to society in general and to U.S. defense and energy policy in particular. It will also explore the history of rare earth elements and China's current monopoly of the industry, including possible repercussions and strategic implications if rare earth elements supply were to be disrupted."--DTIC.

This continuing authoritative series deals with the chemistry, materials science, physics and technology of the rare earth elements in an integrated manner. Each chapter is a comprehensive, up-to-date, critical review of a particular segment of the field. The work offers the researcher and graduate student a complete and thorough coverage of this fascinating field. Authoritative Comprehensive Up-to-date Critical

Developments in Geochemistry, Volume 2: Rare Earth Element Geochemistry presents the remarkable developments in the chemistry and geochemistry of the rare earth elements. This book discusses the analytical techniques and the recognition that rare earth fractionation occurs naturally in different ways. Organized into 13 chapters, this volume begins with an overview of the wide array of types and sizes of the cation coordination polyhedral in rock-forming minerals. This text then examines the application of rare earth element abundances to petrogenetic problems that has centered on the evolution of igneous rocks. Other chapters consider the matching of observed rare earth element abundances with those provided by the theoretical modeling of petrogenetic processes. This book discusses as well the hypotheses on the genesis of a rock or mineral suite. The final chapter deals with the principal analytical methods. This book is a valuable resource for undergraduates, lecturers, and researchers who study petrology and

geochemistry.
Volume 21 of Reviews in Mineralogy treats a short course on the rare earth elements to about 80 participants in San Francisco, California, December 1-3, 1989, just prior to the fall meeting of the American Geophysical Union. Contents: Cosmochemistry of the Rare Earth Elements: Condensation and Evaporation Processes Radiogenic Isotope Geochemistry of Rare Earth Elements Partitioning of Rare Earth Elements between Major Silicate Minerals and Basaltic Melts An Approach to Trace Element Modeling Using a Simple Igneous System as an Example Rare Earth Elements in Upper Mantle Rocks Rare Earth Elements in Metamorphic Rocks Rare Earth Elements in Sedimentary Rocks: Influence of Provenance and Sedimentary Processes Aqueous Geochemistry of Rare Earth Elements Rare Earth Elements in Lunar Materials Compositional and Phase Relations among Rare Earth Element Minerals Economic Geology of Rare Earth Minerals Cathodoluminescence Emission Spectra of Rare Earth Element Activators in Minerals

The paper analyses the peculiar structure of the rare earth elements (REE) industry, a sector dominated by China, and the global implications of current upheavals within the sector, especially as they concern South Africa's (re)emerging rare earths production. REEs are a hitherto obscure group of metals that have now assumed global significance. They are especially critical to modern high-strength magnets and constitute vital inputs for a growing range of mass consumer, "green" technology and military applications. It is important to understand that REEs altogether comprise 17 different metals which, although found together in various combinations, differ in relative abundance and breadth of possible applications. There are therefore large variations in prices and criticality of supply between the different elements. The Chinese rare earths industry has secured a 97% share of upstream production by means of aggressive pricing, backed by state support and technology transfer. Beijing is now attempting to consolidate the industry, crack down on illegal mining and restrict and enforce export and production quotas. Official explanations stress renewed concern for environmental issues and the protection of scarce resources from over-exploitation. Also significant, however, is a policy of deliberately using export restrictions to leverage non-Chinese prices, in order to induce foreign downstream producers to relocate production to China. This process is beginning; although there are also two other forms of international response. First, there is demand destruction either through increased efficiency in REE usage, substitution or recycling of rare earths. Secondly -- and most widely known -- are attempts to restart REE supply chains outside China. South Africa is in the forefront of these efforts through two, globally significant, extractive projects. The refurbished Steenkampskraal thorium and REE mine may be the first non-Chinese new producer to come online, in 2012-2013. The Zandkopsdrift development in Northern Cape is less advanced, but is among the largest prospective new REE mines. Both are joint ventures between Western junior mining companies and East Asian parastatals, respectively from China and Korea. Significant environmental risks seem inherent in the extraction and separation of REEs, especially from thorium waste, although apparently this has not reached the public consciousness in the areas immediately around the South African mines. If these dangers can be avoided or minimised, the new rare earths mines could make a small but significant positive developmental impact at local as well as national level.

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Chapter 7. CARL AUER VON WELSBACH A PIONEER IN THE INDUSTRIAL APPLICATION OF RARE EAR THS . . . . 113 E. BAUMGARTNER . . . .
Rare earths are elements that are found in the Earth's crust, and are vital ingredients for the production of a wide variety of high tech, defense, and green technologies -- everything from iPhones and medical technologies, to wind turbines, efficiency lighting, smart bombs, and submarines. While they are not particularly "rare" in availability, they are difficult and expensive to mine. Yet, China has managed to gain control over an estimated 97 percent of the rare earth industry since the 1990s through cheap production, high export taxes, and artificial limitations of supply. Rare earths, and China's monopoly over them, became international

news after China "unofficially" halted exports to Japan, the United States, and Europe in 2010. This embargo followed a collision between Chinese and Japanese boats in the East China Sea, a locus of geopolitical and economic tension between the two countries. Although the World Trade Organization forced China to scrap its restrictions, it still holds a stranglehold over these elements that are so critical to the economic and security interests of the United States and its allies. Sophia Kalantzakos argues that the 2010 rare earth crisis signaled more than just a trade dispute. Rather, it raises questions about China's use of economic statecraft, and must be regarded as a part of the larger discourse of global power relations. Importantly, this book also argues that the failure of political actors in the United States and Europe to pass policy to address future supply, or the scientific and business communities to devise sustainable rare earth production outside of China, points to future resource competition. Focusing on China's monopoly over the rare earth industry, this book examines the impacts of growing worldwide resource competition and the complexities policymakers face as they develop strategies and responses in an increasingly globalized world.
Lanthanides are of great importance for the electronic industries, this new book (from the EIBC Book Series) provides a comprehensive coverage of the basic chemistry, particularly inorganic chemistry,

of the lanthanoid elements, those having a 4f shell of electrons. A chapter is describing the similarity of the Group 3 elements, Sc, Y, La, the group from which the lanthanoids originate and the group 13 elements, particularly aluminum, having similar properties. Inclusion of the group 3 and 13 elements demonstrates how the lanthanoid elements relate to other, more common, elements in the Periodic Table. Beginning chapters describe the occurrence and mineralogy of the elements, with a focus on structural features observed in compounds described in later chapters. The majority of the chapters is organized by the oxidation state of the elements, Ln(0), Ln(II), Ln(III), and Ln(IV). Within this organization the chapters are further distinguished by type of compound, inorganic (oxides and hydroxides, aqueous speciation, halides, alkoxides, amides and thiolates, and chelates) and organometallic. Concluding chapters deal with diverse and critically important applications of the lanthanoids in electronic and magnetic materials, and medical imaging.

Contents: (1) Intro.; (2) What are Rare Earth Elements (REE)?; (3) Major End Uses and Applications: Demand for REE; The Application of REE in National Defense; (4) Rare Earth Resources and Production Potential; Supply Chain Issues; Role of China; (5) Rare Earth Legislation in the 111th Congress: H.R. 4866, and S. 3521, the Rare Earths

Supply-Chain Technology and Resources Transformation Act of 2010; H.R. 5136, the FY 2011 Nat. Defense Authorization Act; P.L. 111-84, the FY 2010 Nat. Defense Authorization Act; (6) Possible Policy Options: Authorize and Appropriate Funding for a USGS Assessment; Support and Encourage Greater Exploration for REE; Challenge China on Its Export Policy; Establish a Stockpile. Illustrations.
Rare earths are essential constituents of more than 100 mineral species and present in many more through substitution. They have a marked geochemical affinity for calcium, titanium, niobium, zirconium, fluoride, phosphate and carbonate ions. Industrially important minerals, which are utilized at present for rare earths production, are essentially three, namely monazite, bastnasite and xenotime. In modern time techniques for exploration of rare earths and yttrium minerals include geologic identification of environments of deposition and surface as well as airborne reconnaissance with magnetometric and radiometric equipment. There are numerous applications of rare earths such as in glass making industry, cracking catalysts, electronic and optoelectronic devices, medical technology, nuclear technology, agriculture, plastic industry etc. Lot of metals and alloys called rare earth are lying in the earth which required to be processed. Some of the important elements extracted from rare earths are uranium, lithium, beryllium, selenium, platinum

metals, tantalum, silicon, molybdenum, manganese, chromium, cadmium, titanium, tungsten, zirconium etc. There are different methods involved in production of metals and non metals from rare earths for example; separation, primary crushing, secondary crushing, wet grinding, dry grinding etc. The rare earths are silver, silverymwhite, or gray metals; they have a high luster, but tarnish readily in air, have high electrical conductivity. The rare earths share many common properties this makes them difficult to separate or even distinguish from each other. There are very small differences in solubility and complex formation between the rare earths. The rare earth metals naturally occur together in minerals. Rare earths are found with non metals, usually in the 3+ oxidation state. At present all the rare earth resources in India are in the form of placer monazite deposits, which also carry other industrially important minerals like ilmenite, rutile, zircon, sillimanite and garnet. Some of the fundamentals of the book are commercially important rare earth minerals, exploration for rare earth resources, rare earth resources of the world, some rare earth minerals and their approximate compositions, rare earths in cracking catalysts, rare earth based phosphors, interdependence of applications and production of rare earths, uranium alloys, conversion of ores to lithium chemicals, characterization and analysis of very pure silicon, derivation of

molybdenum metal, electoplating and chromizing, electrolytic production of titanium, heat treatment of titanium alloys, tensile properties of alloys etc. The book covers occurrence of rare earth, resources of the world, production of lithium metals, compounds derived from the metals, chemical properties of beryllium, uses of selenium, derivation of molybdenum metals, ore concentration and treatment and many more. This is a unique book of its kind, which will be a great asset for scientists, researchers, technocrats and entrepreneurs.
Magnesium-based alloys containing rare-earth metals are important structural materials, as they combine low density with high-strength properties. This makes them particularly attractive for industry, especially in cases where the low weight of constructions is critical, as in aircraft and space apparatus construction. One of the remarkable features of alloys is the significant difference made by individual rare-earth metals when they are added to magnesium. This second edition of Magnesium Alloys Containing Rare-Earth Metals: Structure and Properties describes the constitution and properties of magnesium-based alloys containing rare-earth metals. It presents the dependence of their characteristics on their atomic number and place in the periodic table and discusses new ideas for rare-earth metals as alloying additives to magnesium. This volume consists mainly of research from

Russian scientists but also contains western literature making it a valuable reference tool for students, researchers and professionals in materials science and metallurgy.

This book describes in a comprehensive manner the technical aspects of separation of rare earth elements into individual elements for industrial and commercial use. The authors include details on and differentiate among the effective separation of rare earth elements for various parts of the world. They introduce new applications of separation of rare earth elements from concentrates of diverse ore types.

Rare earth elements (REEs), the vitamins for modern societies, have been considered some of the most critical elements. They are essential in various industrial applications. With rapid growth in the consumption of rare earths due to the development of new clean energy and defense-related technologies, the demand for these elements have become higher and higher. However, opening a new mine is an expensive, time-intensive process. As a result, reclaiming the rare earth metals from REE-containing end-of-life electronics has become one approach of reducing US dependence on import of these critical materials. The phosphor material used in fluorescent lighting, containing rare earth elements such as cerium, europium, lanthanum, terbium and yttrium, is one of the most accessible sources of REEs in our daily life. Annually, over 680 million fluorescent lamps are reportedly disposed of in the United States. It not only increases the environmental burden, but is also a waste of valuable rare earth elements. Therefore, developing innovative technologies of recycling REEs from end-of-life fluorescent lamps has become critical. In fluorescent lamps, mercury is used to generate UV light with a wavelength of 254 nm, which in turn excites the phosphors to produce visible light. Mercury is highly toxic and listed as a hazardous substance by the USEPA. To reuse or reclaim spent rare earth phosphors, the first step is to remove mercury from them. The traditional ways for removing mercury from phosphors are either time-consuming or energy-intensive. By using a NaCl/NaOCl solution with the assistance of ultrasound, the mercury level in the spent phosphors can be reduced rapidly in a few minutes and meet the USEPA standards for universal non-hazardous wastes. The rare earth elements in the fluorescent phosphors exist in various chemical forms. Typically, europium and yttrium are in oxide forms; cerium, lanthanum and terbium are doped in phosphate or aluminate matrices. Rare earth oxides are soluble in acids, and therefore, the europium and yttrium in spent fluorescent phosphors can be easily extracted by acids. However, phosphate and aluminate matrices are more chemically stable. As a result, extracting cerium, lanthanum and terbium from the phosphors requires a pretreatment procedure. By pretreating the phosphors with sodium peroxide at 650 °C, cerium, lanthanum and terbium in the treated phosphors become extractable by supercritical fluid carbon dioxide (sc-CO2). The extraction efficiencies for cerium, lanthanum and terbium are over 96% using a trin-butylphosphate-HNO3 extractant in sc-CO2. With the assistance of ultrasound, direct extraction of the REEs from the phosphors by nitric acid at elevated temperature is also possible. For example, with nitric acid of 11M at 80°C under sonication for 1 hour over 99% of cerium, europium, lanthanum and yttrium as well as 93% of terbium could be extracted from the fluorescent phosphors.

Episodes from the History of the Rare Earth ElementsSpringer Science & Business Media

Seminar paper from the year 2012 in the subject Business economics - Economic Policy, grade: -, -, language: English, abstract: Almost twenty years after Deng Xiaoping stated: 'There is oil in the Middle East, but there is rare earth in China, ' the country controls the REE global supply almost solely. Recent Chinese policies of raising taxes and cutting export quotas combined with its temporary ban on REE exports led not only to steadily increasing prices. Most notably it created uncertainty among companies producing outside Chine whether they will be able to get sufficient amounts of REE in the future and how much this is going to cost. Because it will take several years until Western mining capacities meet Western companies' demand, some manufacturers in need of REE have already started to relocate their factories to China. Beijing claims that their policies are dedicated to tackle environmental problems which have been caused by mining REE. However, taken into account that Beijing policies also require Chinese partners for foreign companies that operate within China, Western companies that relocate their facilities may risk handing over knowledge to future competitors. Aware of the consequences that Beijing's new fondness for environmental issues brings, governments and companies especially in Japan, the U.S. and Europe try to find ways to decrease their dependencies. This report examines factors that led to China's dominance on the REE market today and presents some counteractions which governments and companies in Japan, the U.S. and Europe have introduced to mitigate this situation. The two principal findings of this report are: first, because Western mining companies will need time to meet their companies' demand, the current situation is going to sustain for at least a few more years to come; and second, although China runs the risk of selling off its REE resources abroad which it needs for its own economy at home, it may benefit from the technology trans

New Frontiers in Rare Earth Science and Applications, Volume II documents the proceedings of the International Conference on Rare Earth Development and Applications held in Beijing on September 10-14, 1985. This compilation discusses quenching and sensitization of rare earth luminescence, magnetic properties of rare earth intermetallics, and microcapsulated rare earth-nickel hydride-forming materials. The effect of rare earth on the quality and properties of hot-rolled steel strips and role of yttrium in heavy section spheroidal graphite cast iron are also elaborated. This book likewise covers the application of scandium oxide in an electron emission material and study on the effect of rare earth elements on the yield of

wheat. This publication is beneficial to researchers and scientists conducting work in the field of earth science.
Handbook on the Physics and Chemistry of Rare Earths: Including Actinides, Volume 53, is a continuous series covering all aspects of rare earth science, including chemistry, life sciences, materials science and physics. The book focuses on rare earth elements [Sc, Y, and the lanthanides (La through Lu], but when relevant, information is included on the related actinide elements. Individual chapters are comprehensive, up-to-date, critical reviews written by highly experienced, invited experts, with this release including chapters on a Comparison of the Electronic Properties of Lanthanides with Formally Isoelectronic Actinides, Redox catalysis with redox-inactive rare-earth ions in artificial photosynthesis, and more. The series, which was started in 1978 by Professor Karl A. Gschneidner Jr., combines, and integrates, both the fundamentals and applications of these elements with two published volumes each year. Presents up-to-date overviews and new developments in the field of rare earths, covering both their physics and chemistry Contains Individual chapters that are comprehensive and broad, with critical reviews Provides contributions from highly experienced, invited experts
The contributors argue that rare earths are essential to the information technology revolution on which humans have come to depend for communication, commerce, and, increasingly, engage in conflict. They demonstrate that rare earths are a strategic commodity over which political actors will and do struggle for control.
This book contains twelve chapters written by both

senior scientists with international fame and young researchers who have been working at the frontiers of related fields for some years. It covers a variety of the most active research areas in rare earths research in recent years. The first five chapters concern a few hot topics on lanthanum photonics and luminesce. The following two chapters probe the physics behind the phenomena, which some theoreticians may be interested in. The first one makes thorough studies on an exotic phenomena, valency fluctuation occurring in metallic perovskite compounds due to the joint influences by both Ce and Eu elements inside. The latter demonstrates, with an example, how a novel ab initio method can be employed to calculate crystal parameters more accurately and efficiently. The final five chapters focus on the researches aimed at finding new applications of rare earths in industry and high technology based on their magnetic, chemical and electrochemical properties, such as, the magnetocaloric effects and performance in magnetic refrigeration of a class of amorphous materials containing heavy rare earth elements; the mechanism and applicability for rare earths to replace chromates as corrosion inhibitors; studies employing a defect cluster model to understand local ordered defect structure formation in doped ceria, and the possibility of using it to optimize the rare earth dopant in ceria for the purpose of improving the ionic conductivity of fluorite oxides? and fabrication and characterization of new La-Mg-Ni electrode alloys by doping them with lanthanides to improve the electrochemical cycle stability and discharge capacity. The audience for this book includes theoretical and applied physicists, specialists in instrumentation (electronics), engineers (electronic, chemical engineering, and biotechnology), chemists and materials scientists in industry and academia.

Illuminates the chemical, economic and geopolitical issues surrounding the world's rare earth metals, identifying their critical role in powering mainstream consumer products and the wars being fought over territories where they are controlled.

This book gives an overview of the worlds literature on analytical data and theoretical concepts of the regularities of rare earth elements (REE) in ultramafic and mafic rocks of different chemical and mineral compositions mantle restites (including those composing mantle xenoliths in alkali basaltoids), highly magnesium hypabyssal roc

Corrosion inhibitors are an important method for minimizing corrosion; however traditional inhibitors such as chromates pose environmental problems. Rare earth metals provide an important, environmentally-friendly alternative. This book provides a comprehensive review of current research and examines how rare earth metals can be used to prevent corrosion and applied to protect metals in such industries as aerospace and construction. Chapter 1 begins by examining the important need to replace chromate, and then goes on to discuss the chemistry of the rare earth metals and their related compounds. Chapter 2 considers the techniques that can be used to identify corrosion inhibition mechanisms and to test the levels of protection offered to different metals by rare earth compounds. Subsequent chapters consider in more detail how rare earth elements can be used as corrosion inhibitors in different forms and for different metals. This includes discussion on the potential of rare earth elements for self-healing, tunable and multifunctional coatings. Finally, chapter 10 considers the cost and availability of the rare earths and the potential health and environmental risks associated with extracting them. Provides a review of current research and examines how rare earth metals can be used to prevent corrosion and applied to protect metals in such industries as aerospace and construction. Includes discussion on the potential of rare earth elements for self-healing, tunable and multifunctional coatings. Considers the cost and availability of the rare earths and the potential health and environmental risks associated with extracting them.

The concentration of production of rare earth elements (REEs) outside the United States raises the important issue of supply vulnerability. REEs are used for new energy technologies and national security applications. Is the United States vulnerable to supply disruptions of REEs? Are these elements essential to U.S. national security and economic well-being? There are 17 rare earth elements (REEs), 15 within the chemical group called lanthanides, plus yttrium and scandium. The lanthanides consist of the following: lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium. Rare earths are moderately abundant in the earth's crust, some even more abundant than copper, lead, gold, and platinum.

While more abundant than many other minerals, REEs are not concentrated enough to make them easily exploitable economically. The United States was once self-reliant in domestically produced REEs, but over the past 15 years has become 100% reliant on imports, primarily from China, because of lower-cost operations. The present book is based on the work of M.N.Bochkarev, G.S.Kalinina, L.N. zakharov and S.Ya.Khorshev. The Russian edition of that book appeared under the same title in 1989 and covered literature data up to the middle of 1986. Since that time the number of publications on this subject increased significantly. In this volume we include all the data published up to the end of 1990, as well as some of the most important relevant articles of 1991. Therefore, this book should be considered as a new book, devoted to the same problems, rather than as just a translation of the mentioned issue. This book deals with compounds of scandium, yttrium, lanthanum and lanthanoids containing direct metal-carbon bond, Le. with the real organometallic complexes of these metals. Besides, the volume includes the rare earth complexes, in which organic ligand is bonded to the metal atom via the atom of another element of the Periodic Table. In other words, the book includes all classes of rare earth organoderivatives. Carboxilates, fl-diketonates and related chelates are the exceptions, because their properties are closer to inorganic compounds and they were fully described elsewhere. It should be noted, that "rare earth elements", "rare earth metals", "lanthanoids" and related terms are used in this book for indicating scandium, yttrium, lanthanum and the following 14 elements of the Periodic Table.

This book deals with the rare earth elements (REE), which are a series of 17 transition metals: scandium, yttrium and the lanthanide series of elements (lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium and lutetium). They are relatively unknown to the wider public, despite their numerous applications and their critical role in many high-tech applications, such as high-temperature superconductors, phosphors (for energy-saving lamps, flat-screen monitors and flat-screen televisions), rechargeable batteries (household and automotive), very strong permanent magnets (used for instance in wind turbines and hard-disk drives), or even in a medical MRI application. This book describes the history of their discovery, the major REE ore minerals and the major ore deposits that are presently being exploited (or are planned to be exploited in the very near future), the physical and chemical properties of REEs, the mineral processing of REE concentrates and their extractive metallurgy, the applications of these elements, their economic aspects and the influential economical role of China, and finally the recycling of the REE, which is an emerging field.

High-technology and environmental applications of the rare-earth elements (REE) have grown dramatically in diversity and importance over the past four decades. This book provides a scientific understanding of rare earth properties and uses, present and future. It also points the way to efficient recycle of the rare earths in end-of-use products and efficient use of rare earths in new products. Scientists and students will appreciate the book's approach to the availability, structure and properties of rare earths and how they have led to myriad critical uses, present and future. Experts should buy this book to get an integrated picture of production and use (present and future) of rare earths and the science behind this picture. This book will prove valuable to.non-scientists as well in order to get an integrated picture of production and use of rare earths in the 21st Century, and the science behind this picture. Defines the chemical, physical and structural properties of rare earths. Gives the reader a basic understanding of what rare earths can do for us. Describes uses of each rare earth with chemical, physics, and structural explanations for the properties that underlie those uses. Allows the reader to understand how rare earths behave and why they are used in present applications and will be used in future applications. Explains to the reader where and how rare earths are found and produced and how they are best recycled to minimize environmental impact and energy and water consumption.