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***Every sector faces unique  
challenges in the  
transition to  
sustainability. Across***

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***each, materials will play a key role. That will depend on novel materials and processes, but these will only be effective with a solid understanding of the trends in the market.***

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***For each respective sector, the papers in this collection will explore the trends and drivers toward sustainability, the enabling materials technologies and***

***challenges, and the tools  
to evaluate their  
implications. Major  
sections in REWAS 2019  
include: Disruptive  
Material Manufacturing:  
Scaling and Systems***

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***Challenges Education and  
Workforce Development  
Rethinking Production  
Secondary and Byproduct  
Sources of Materials,  
Minerals, and Metals  
In this volume, operators,***

*Page 5/182*

***engineers, and  
researchers present  
information about all  
aspects of current  
processing technologies  
for nickel and cobalt, as  
well as emerging***

***technologies for both metals. Contributions from industry and academia encompass metallurgical aspects of metals commonly associated with nickel***

***and cobalt, such as copper and platinum group metals (PGMs). Specific focus areas of the collection include, but are not limited to mineral processing, metallurgy of***



***nickel and cobalt ores,  
battery materials,  
recycling, recovery of  
associated byproducts  
and PGMs, and sulfide  
and laterite processing.  
Commercial development***

***of energy from  
renewables and nuclear  
is critical to long-term  
industry and  
environmental goals.  
However, it will take time  
for them to economically***

***compete with existing fossil fuel energy resources and their infrastructures. Gas fuels play an important role during and beyond this transition away from***

***fossil fuel dominance to a  
balanced approach to  
fossil, nuclear, and  
renewable energies.  
Chemical Energy from  
Natural and Synthetic  
Gas illustrates this point***

***by examining the many roles of natural and synthetic gas in the energy and fuel industry, addressing it as both a "transition" and "end game" fuel. The book***

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***describes various types of gaseous fuels and how are they are recovered, purified, and converted to liquid fuels and electricity generation and used for other static and***

***mobile applications. It emphasizes methane, syngas, and hydrogen as fuels, although other volatile hydrocarbons are considered. It also covers storage and***

***transportation  
infrastructure for natural  
gas and hydrogen and  
methods and processes  
for cleaning and  
reforming synthetic gas.  
The book also deals***



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***applications, such as the use of natural gas in power production in power plants, engines, turbines, and vehicle needs. Presents a unified and collective look at gas***

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***in the energy and fuel industry, addressing it as both a "transition" and "end game" fuel.***

***Emphasizes methane, syngas, and hydrogen as fuels. Covers gas storage***

***and transport  
infrastructure. Discusses  
thermal gasification, gas  
reforming, processing,  
purification and  
upgrading. Describes  
biogas and bio-hydrogen***

***production. Deals with the use of natural gas in power production in power plants, engines, turbines, and vehicle needs.***

***Corrosion of nuclear***

***materials, i.e. the interaction between these materials and their environments, is a major issue for plant safety as well as for operation and economic***

***competitiveness.  
Understanding these  
corrosion mechanisms,  
the systems and  
materials they affect, and  
the methods to  
accurately measure their***

***incidence is of critical importance to the nuclear industry. Combining assessment techniques and analytical models into this understanding allows operators to***

***predict the service life of  
corrosion-affected  
nuclear plant materials,  
and to apply the most  
appropriate maintenance  
and mitigation options to  
ensure safe long term***



***operation. This book critically reviews the fundamental corrosion mechanisms that affect nuclear power plants and facilities. Initial sections introduce the complex***

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***field of nuclear corrosion science, with detailed chapters on the different types of both aqueous and non aqueous corrosion mechanisms and the nuclear materials***

*Page 26/182*

***susceptible to attack  
from them. This is  
complemented by  
reviews of monitoring  
and control  
methodologies, as well as  
modelling and lifetime***

***prediction approaches.  
Given that corrosion is an  
applied science, the final  
sections review corrosion  
issues across the range  
of current and next-  
generation nuclear***

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***reactors, and across such nuclear applications as fuel reprocessing facilities, radioactive waste storage and geological disposal systems. With its***

***distinguished editor and  
international team of  
expert contributors,  
Nuclear corrosion science  
and engineering is an  
invaluable reference for  
nuclear metallurgists,***

***materials scientists and  
engineers, as well as  
nuclear facility operators,  
regulators and  
consultants, and  
researchers and  
academics in this field.***

***Comprehensively reviews  
the fundamental  
corrosion mechanisms  
that affect nuclear power  
plants and facilities  
Chapters assess different  
types of both aqueous***



***and non aqueous  
corrosion mechanisms  
and the nuclear materials  
susceptible to attack  
from them Considers  
monitoring and control  
methodologies, as well as***

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***modelling and lifetime  
prediction approaches  
Recent Advances in Solar-  
driven Thermochemical  
Fuel Production and  
Thermal Energy Storage  
Celebrating the***

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***Megascale  
Extractive Metallurgy of  
Copper, Nickel, and  
Cobalt  
Materials Processing  
Fundamentals 2017  
Transport Phenomena***

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***and Transport Processes  
Handbook of Recycling***

*Intermediate Temperature Solid  
Oxide Fuel Cells: Electrolytes,  
Electrodes and Interconnects  
introduces the fundamental  
principles of intermediate solid*

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*oxide fuel cells technology. It provides the reader with a broad understanding and practical knowledge of the electrodes, pyrochlore/perovskite/oxide electrolytes and interconnects*

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*which form the backbone of the Solid Oxide Fuel Cell (SOFC) unit. Opening with an introduction to the thermodynamics, physiochemical and electrochemical behavior of*

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*Solid Oxide Fuel Cells (SOFC), the book also discusses specific materials, including low temperature brownmillerites and aurivillius electrolytes, as well as pyrochlore interconnects. This book*

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*analyzes the basic concepts, providing cutting-edge information for both researchers and students. It is a complete reference for Intermediate Solid Oxide Fuel Cells technology that will be a vital resource for those*



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*working in materials science,  
fuel cells and solid state  
chemistry. Provides a single  
source of information on glass,  
electrolytes, interconnects,  
vanadates, pyrochlores and  
perovskite SOFC Includes*

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*illustrations that provide a clear visual explanation of concepts being discussed Progresses from a discussion of basic concepts that will enable readers to easily comprehend the subject matter*

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*Metal recycling is a complex business that is becoming increasingly difficult! Recycling started long ago, when people realized that it was more resource- and cost-efficient than just throwing away the*

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*resources and starting all over again. In this report, we discuss how to increase metal-recycling rates and thus resource efficiency from both quantity and quality viewpoints. The discussion is based on data*

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*about recycling input, and the technological infrastructure and worldwide economic realities of recycling. Decision-makers set increasingly ambitious targets for recycling, but far too much valuable metal today is lost*

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*because of the imperfect collection of end-of-life (EoL) products, improper practices, or structural deficiencies within the recycling chain, which hinder achieving our goals of high resource efficiency and resource*

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*security, and of better recycling rates.*

*Advances in synthesis of metallic, oxidic and composite powders were presented via the following methods: ultrasound-assisted leaching, ultrasonic*

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*spray pyrolysis, hydrogenation,  
dehydrogenation, ball milling,  
molten salt electrolysis,  
galvanostatic electrolysis,  
hydrogen reduction,  
thermochemical decomposition,  
inductively coupled thermal*



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*plasma, precipitation and high pressure carbonation in an autoclave. This Special Issue contains 17 papers from Europe, Asia, Australia, South Africa and the Balkans. The synthesis was focused on metals: Co, Cu; Re;*

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*oxides: ZnO, MgO, SiO<sub>2</sub>; V<sub>2</sub>O<sub>5</sub>;  
sulfides: MoS<sub>2</sub>, core shell  
material: Cu-Al<sub>2</sub>O<sub>3</sub>, Pt/TiO<sub>2</sub>;  
compounds:  
Ca<sub>0.75</sub>Ce<sub>0.25</sub>ZrTi<sub>2</sub>O<sub>7</sub>, Mo<sub>5</sub>Si<sub>3</sub>,  
Ti<sub>6</sub>Al<sub>4</sub>V. The environmentally  
friendly strategies were*

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*presented at the carbonation of olivine, treatment of acid mine drainage water and production of vanadium oxide.*

*This book focuses on the engineering aspects of phosphorus (P) recovery and*

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*recycling, presenting recent research advances and applications of technologies in this important and challenging area of engineering. It highlights full-scale applications to illustrate the performance and*

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*effectiveness of the new technologies. As an essential element for all living organisms, P cannot be replaced by any other element in biochemical processes, humans ultimately rely its availability. Today, P is*

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*mostly obtained from mined rock phosphate (Pi). However, natural reserves of high-grade rock Pi are limited and dwindling on a global scale. As such, there have been increased efforts to recycle P from secondary*

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*sources, including sewage sludge, animal manure, food waste, and steelmaking slag, and so close the anthropogenic P cycle. In addition to various aspects of phosphorus covered by other literature, including*

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*chemistry, biochemistry,  
ecology, soil-plant systems and  
sustainable management, this  
book is a valuable and  
comprehensive source of  
information on the rapidly  
evolving field of P recovery and*



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*recycling engineering for  
students, researchers, and  
professionals responsible for  
sustainable use of phosphorus.*

*A History of Outokumpu*

*REWAS 2016*

*CdTe and Related Compounds;*

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*Physics, Defects, Hetero- and  
Nano-structures, Crystal  
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Applied Mineralogy in the  
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*Interconnects*

*Manufacturing the Circular  
Materials Economy*

**This collection presents  
papers from a symposium on  
extraction of rare metals as  
well as rare extraction**

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processing techniques used in metal production. It covers metals essential for critical modern technologies including electronics, electric motors, generators, energy storage systems, and specialty alloys. Rare

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metals are the main building blocks of many emerging critical technologies and have been receiving significant attention in recent years. Much research in academia and industry is devoted to finding novel

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techniques to extract critical and rare metals from primary and secondary sources. The technologies that rely on critical metals are dominating the world, and finding a way to extract and supply them effectively

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is highly desirable and beneficial. Rapid development of these technologies entails fast advancement of the resource and processing industry for their building materials. Authors from academia and

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industry exchange knowledge on developing, operating, and advancing extractive and processing technologies. Contributions cover rare-earth elements (magnets, catalysts, phosphors, and others), energy storage



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materials (lithium, cobalt, vanadium, graphite), alloy elements (scandium, niobium, titanium), and materials for electronics (gallium, germanium, indium, gold, silver). The contributions also cover various

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processing techniques in  
mineral beneficiation,  
hydrometallurgy, separation  
and purification,  
pyrometallurgy,  
electrometallurgy,  
supercritical fluid  
extraction, and recycling

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(batteries, magnets,  
electrical and electronic  
equipment).

At last geochemists are  
offered one comprehensive  
reference book which gives  
the Eh-pH diagrams for 75  
elements found in the

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earth's surface environment,  
including transuranic and  
other radioactive species.  
For each of these newly  
calculated diagrams short  
explanatory texts are added.  
For the first time the  
primary elements are

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considered in water with metal, sulfur, carbon, and other species as appropriate. Furthermore, based on these figures and up-to-date thermodynamic data presented in this reference, researchers can

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predict the behavior of elements in the surface environment. Geoscientists, chemists and environmental agencies will also benefit from several brief texts on the importance of various elements to problems of

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Gold Ore Processing: Project  
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perspective that is vital to the successful and responsible development, operation, and closure of any gold ore processing operation. This completely updated edition features coverage of established,



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newly implemented, and  
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geometallurgy, cyanide code  
compliance, recovery of gold  
from e-waste, handling of

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management, solid-liquid  
separation, and treatment of  
challenging ores such as  
double refractory**

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industry, including metallurgists, geologists, chemists, mining engineers, and many others. Includes several new chapters presenting established, newly implemented, and emerging technologies in

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Offers a mineralogy-based

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has application to multiple  
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This landmark publication  
distills the body of  
knowledge that characterizes  
mineral processing and

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extractive metallurgy as disciplinary fields. It will inspire and inform current and future generations of minerals and metallurgy professionals. Mineral processing and extractive metallurgy are atypical

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disciplines, requiring a combination of knowledge, experience, and art.

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inclusive reference  
addresses the magnitude of  
traditional industry topics  
and also addresses the new  
technologies and important  
cultural and social issues  
that are important today.  
Contents Mineral

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**within modern metallurgy.  
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theory; major ferroalloy  
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ferroalloys.**

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as well as physical and**

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Process Mineralogy  
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The LithoRec Way  
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The volume contains more than 70 papers covering the important topics and issues in metallurgy today including papers as follows: keynote papers covering a tribute to David Robertson, workforce skills needed in the profession going forward, copper smelting, ladle metallurgy, process



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metallurgy and resource efficiency, new flash iron making technology, ferro-alloy electric furnace smelting and on the role of bubbles in metallurgical processing operations. Topics covered in detail in this volume include ferro-alloys, non-ferrous metallurgy, iron and steel, modeling,

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Presents a comprehensive look at atmospheric corrosion, combining expertise in corrosion science and atmospheric chemistry Is an invaluable resource for corrosion scientists, corrosion engineers, and anyone interested in the theory and

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controlled and uncontrolled environments Details degradation of materials in architectural and structural applications, electronic devices, and cultural artifacts Includes appendices with data on specific materials, experimental techniques, atmospheric species

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Techniques of performing applied mineralogy investigations, and applications and capabilities of recently developed instruments for measuring mineral properties are explored in this book intended for practicing applied mineralogists, students in mineralogy and

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metallurgy, and mineral processing engineers. The benefits of applied mineralogy are presented by using in-depth applied mineralogy studies on base metal ores, gold ores, porphyry copper ores, iron ores and industrial minerals as examples. The chapter on base metal ores includes a discussion

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on the effects of liberation, particle sizes and surfaces coatings of Pb, Cu, Fe, Ca and  $\text{SO}_4^{2-}$  on the recoveries of sphalerite, galena and chalcopyrite. The chapter on gold discusses various methods of determining the quantities of gold in different minerals, including 'invisible' gold in pyrite and

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arsenopyrite, so that a balance of the distribution of gold among the minerals can be calculated. This book also discusses the roles of pyrite, oxygen, moisture and bacterial (thiobacillus ferrooxidans) on reactions that produce acidic drainage from tailings piles, and summarizes



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currently used and proposed methods of remediation of acidic drainage. This four-volume reference work builds upon the success of past editions of Elsevier ' s Corrosion title (by Shreir, Jarman, and Burstein), covering the range of innovations and applications that have emerged in the

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coverage of all aspects of the corrosion phenomenon, from the science behind corrosion of metallic and non-metallic materials in liquids and gases to the management of corrosion in specific industries and applications Features cutting-edge topics such as medical applications,

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Conference on Extractive  
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Rare Earths elements are composed of 15 chemical elements in the periodic table. Scandium and yttrium have similar properties, with mineral assemblages, and are therefore referred alike in the literature.

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Although abundant in the planet surface, the Rare Earths are not found in concentrated forms, thus making them economically valued as they are so challenging to obtain. Rare Earths Industry: Technological, Economic and Environmental Implications provides an



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interdisciplinary orientation to the topic of Rare Earths with a focus on technical, scientific, academic, economic, and environmental issues. Part I of book deals with the Rare Earths Reserves and Mining, Part II focuses on Rare Earths Processes and High-Tech Product Development,

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and Part III deals with Rare Earths Recycling Opportunities and Challenges. The chapters provide updated information and priceless analysis of the theme, and they seek to present the latest techniques, approaches, processes and technologies that can reduce the

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costs of compliance with environmental concerns in a way it is possible to anticipate and mitigate emerging problems. Discusses the influence of policy on Rare Earth Elements to help raise interest in developing strategies for management resource development

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and exploitation Global contributions will address solutions in countries that are high RE producers, including China, Brazil, Australia, and South China End of chapter critical summaries outline the technological, economic and environmental implications of rare

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earths reserves, exploration and market Provides a concise, but meaningful, geopolitical analysis of the current worldwide scenario and importance of rare earths exploration for governments, corporate groups, and local stakeholders

This three volume set presents

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papers from the first collaborative global metallurgy conference focused exclusively on extractive topics, including business and economic issues. Contributions examine new developments in foundational extractive metallurgy topics and techniques, and present the latest

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research and insights on emerging technologies and issues that are shaping the global extractive metallurgy industry. The book is organized around the following main themes: hydrometallurgy, pyrometallurgy, sulfide flotation, and extractive metallurgy markets and

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economics.

This book describes and explains the methods by which three related ores and recyclables are made into high purity metals and chemicals, for materials processing. It focuses on present day processes and future developments rather than historical



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processes. Nickel, cobalt and platinum group metals are key elements for materials processing. They occur together in one book because they (i) map together on the periodic table (ii) occur together in many ores and (iii) are natural partners for further materials

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processing and materials manufacturing. They all are, for example, important catalysts - with platinum group metals being especially important for reducing car and truck emissions. Stainless steels and CoNiFe airplane engine super alloys are examples of practical

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usage. The product emphasises a sequential, building-block approach to the subject gained through the author's previous writings (particularly Extractive Metallurgy of Copper in four editions) and extensive experience. Due to the multiple metals involved and because

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each metal originates in several types of ore - e.g. tropical ores and arctic ores this necessitates a multi-contributor work drawing from multiple networks and both engineering and science. Synthesizes detailed review of the fundamental chemistry and physics of extractive

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