

Section 1. Research Writing Basics

Unit 3. Organization of a research paper

Outline

- The essential elements of a research article
- Their peculiarities and functions

Title



Article

Hot Isostatic Pressing of Aluminum–Silicon Alloys Fabricated by Laser Powder-Bed Fusion

- the «face of the paper»
- a concise and informative description
- an indexing tool

Information about the authors



Article

Hot Isostatic Pressing of Aluminum–Silicon Alloys Fabricated by Laser Powder-Bed Fusion

Stephan Hafenstein ^{1,*} , Leonhard Hitzler ¹ , Enes Sert ², Andreas Öchsner ² ,
Markus Merkel ³  and Ewald Werner ¹

Information about the authors



Article

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Review

Lithium Production and Recovery Methods: Overview of Lithium Losses

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Abstract writing

■ one-paragraph long summary (IMRD)

The length: 150–250 words

Structure: one sentence descriptions
of each of the sections

Abstract

Abstract

The objective of this study is to describe primary lithium production and to summarize the methods for combined mechanical and hydrometallurgical recycling of lithium-ion batteries (LIBs). This study also aims to draw attention to the problem of lithium losses, which occur in individual recycling steps. The first step of hydrometallurgical treatment is leaching, which is an effective method capable of transferring over 99% of the present metals to the leach solutions. Extraction of metals after leaching can be conducted using various methods, with precipitation being the most commonly used. The precipitation of other metals can result in the co-precipitation of lithium, causing total lithium losses up to 30%. To prevent such losses, solvent extraction methods are used to selectively remove elements, such as Co, Ni, Al, and Mn. Solvent extraction (SX) is highly effective, reducing the losses to 3% per extraction stage and reducing overall lithium losses to 15%. After the refining, lithium is precipitated as lithium carbonate. High lithium carbonate solubility (1.5 g/L) and high liquid to solid leaching ratios require costly and avoidable operations to be implemented in order to enhance lithium concentration. Therefore, it is suggested that more studies should focus on multistage leaching with lower L/S ratios.

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Objective

Methodology

Findings

Conclusion

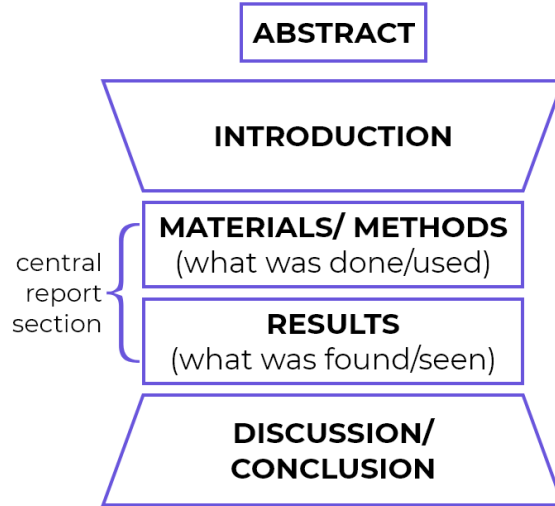
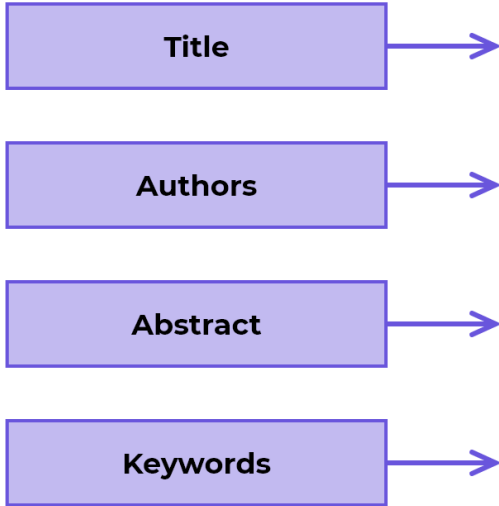
Keywords

■ the words by which the paper should be indexed by abstracting services

Abstract

The objective of this study is to describe primary lithium production and to summarize the methods for combined mechanical and hydrometallurgical recycling of lithium-ion batteries (LIBs). This study also aims to draw attention to the problem of lithium losses, which occur in individual recycling steps. The first step of hydrometallurgical treatment is leaching, which is an effective method capable of transferring over 99% of the present metals to the leach solutions. Extraction of metals after leaching can be conducted using various methods, with precipitation being the most commonly used. The precipitation of other metals can result in the co-precipitation of lithium, causing total lithium losses up to 30%. To prevent such losses, solvent extraction methods are used to selectively remove elements, such as Co, Ni, Al, and Mn. Solvent extraction (SX) is highly effective, reducing the losses to 3% per extraction stage and reducing overall lithium losses to 15%. After the refining, lithium is precipitated as lithium carbonate. High lithium carbonate solubility (1.5 g/L) and high liquid to solid leaching ratios require costly and avoidable operations to be implemented in order to enhance lithium concentration. Therefore, it is suggested that more studies should focus on multistage leaching with lower L/S ratios.

Keywords: lithium-ion battery; recycling; lithium; hydrometallurgy; leaching; lithium losses; critical raw materials; solvent extraction



Conclusion

■ the main findings, the overall conclusions and implications

By removing the p-group atom from the X₂YZ composition, novel functional all-d-metal Heusler alloys are developed. These findings contribute to our knowledge of the role of orbital hybridization in the fundamental and functional features of X₂YZ Heusler alloys. According to the current study, despite the lack of a p-group atom, the martensitic transition with adjustable MT by chemical composition occurs. Finally, substituting a transition metal for the p-group enhances mechanical ductility and results in considerable reversible MCE. The suppression of p–d hybridization and the growth of d–d hybridizations is the key physical process that combines remarkable mechanical features with huge MCE. Because of their optimal functional behavior, these alloys are a possible new class of materials for technological applications. We advocate focusing future research on the atomic site occupancy rules of these kinds of alloys. The influence of d–d hybridizations on atomic ordering may be shown by evaluating structural and magnetic properties when the quantity of the p-atom group decreases. Furthermore, the impact of thermal annealing techniques, as well as several synthesis methods on the creation of the L2 1 phase, should be further investigated. Finally, because of the increased mechanical ductility and high induced strain values observed, the shape memory impact of ternary Ni₂xMn_{1+x}Tix and Mn₂xNi_{1+x}Tix series should be further investigated

Acknowledgement

■ to acknowledge the contributions of all those who have helped in the process of publishing a paper

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a list of all the sources cited in the research paper

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Similarities and differences

References

What is the references section?

All citations from the text

The References and text citations should match perfectly

What is the purpose?

To locate and verify the sources used in the research

Bibliography

What is the bibliography?

Includes both referenced sources and other relevant sources not directly cited in the paper

What is the purpose?

For background information or to gain insights into the subject matter

Appendix (appendices)

the information of secondary importance

Appendix A

The Engineering Design Process

A Descriptive View

CHAPTER MENU	
A.1	Design and Development, 248
A.1.1	The Design Process, 248
A.1.2	Customer Requirements, 249
A.1.3	Interactive Design, 249
A.1.4	Intermediate Testing, 249
A.1.5	Final Iteration, 251
A.2	Forensic Analysis of the Design Process, 252
	References, 253

When we think of *design*, great artists and builders come to mind, such as Michelangelo, Leonardo da Vinci, Berthe Morisot, or Christopher Wren. We imagine that design is mostly creativity and certainly it is that, but there is much more to it. True, the essence of design is creativity. No standard in the world can mandate or bestow creativity. You either have it or you don't, but creativity is brought to life through a design process that is well identified. For example, Michelangelo followed a detailed process in both

