

Section 2. Introduction as an IMRD component

Unit 3. Introduction: Vocabulary features

Outline

Vocabulary for the following four components of the introduction section model:

- Establishing the importance of the field
- Previous and/or current research and contributions
- Locating a gap in the research
- Brief outline of the paper

Components of the introduction

How to

Example

- | | |
|--|---|
| 1. Establish the importance of the field | <ul style="list-style-type: none">• Much research in recent years.... |
| 2. Describe previous and/or current research and contributions | <ul style="list-style-type: none">• Use describing verbs: calculated, monitored
Instead of: did, showed and found• Use Past Simple |
| 3. Locate the gap/problem/question/prediction | <ul style="list-style-type: none">• However, few studies have focused on... |
| 4. Present brief outline of the work/paper | <ul style="list-style-type: none">• The aims of the present work are as follows... |

A sample introduction section

The synthesis of high-strength alloys from copper and zinc

Introduction

1 Copper-zinc alloys have gained significant attention in recent years due to their exceptional strength and corrosion resistance, which offer important benefits in various industrial applications. **2** These alloys are produced by combining copper and zinc through a process of metallurgy. **3** They have potential uses in the biomedical field¹ and have also been investigated as potential engineering materials.^{2,3} **4** However, the alloys have been found to be too brittle under impact to be used commercially.⁴ **5** One way to improve the mechanical properties of alloys is to incorporate other elements into the mixture⁵ and there has been extensive research regarding the modification of copper-zinc alloys. **6** For example, Smith et al. showed that copper-zinc alloys could be prepared using blending techniques⁶ and more recently, Hill established the toughness of such alloys.⁷ **7** However, although the effect of the added elements on the mechanical properties of the alloys was demonstrated over two years ago,⁸ little attention has been paid to the selection of appropriate elements. **8** The present paper presents a set of criteria for selecting such elements. **9** On the basis of these criteria, it then describes the preparation of a set of alloys using copper and a nickel alloy (Ni-Cu). **10** This combination of two distinct metals formed a novel alloy in which the incorporation of Ni-Cu significantly increased strength and ductility.

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The importance
of the field

What else?

- (a) central problem
- (a) challenging area
- (a) considerable number
- (a) crucial issue
- (a) current problem
- (a) dramatic increase
- (an) essential element
- (a) fundamental issue
- (an) increasing number
- (a) key technique
- (a) popular method
- (a) powerful tool/method
- (a) significant increase

What else?

- (has) focused (on)
- for a number of years
- (has been) extensively studied
- importance/important
- in recent years
- Nowadays
- numerous investigations
- of great concern
- of growing interest
- over the past ten years
- play a key role (in)/play a major part (in)
- potential applications
- recent decades /recent(ly)
- today / usually
- typical(ly)

What else?

1. Using key terminology
2. Highlighting industrial applications
3. Emphasizing advancements and innovations
4. Referencing research contributions
5. Discussing societal relevance

What else?

1. Using key terminology

«**Metallic alloys**, composite materials formed by combining two or more metallic elements, are widely utilized in various industries due to their exceptional **mechanical properties** and **versatility**.»

2. Highlighting industrial applications:

«Alloys **have revolutionized the aerospace industry** by providing lightweight yet strong materials for aircraft construction, enhancing fuel efficiency and ensuring passenger safety.»

What else?

3. Emphasizing advancements and innovations:

«**The development of nanocrystalline alloys, with grain sizes** in the nanometer range, **has opened new avenues** for enhancing mechanical strength while maintaining excellent corrosion resistance.»

4. Referencing research contributions:

It has been generally accepted that the main precipitation sequence of Al-Mg-Si alloys during artificial aging treatment is: SSSS (super-saturated solid solution) → GP zones → β'' → β' , U1, U2 → β [1][2][38].

What else?

5. Discussing societal relevance:

«The development of biocompatible alloys has revolutionized the field of medical implants, **enabling long-lasting and safe solutions for patients with enhanced biocompatibility and corrosion resistance.**»

More examples

- **Numerous experiments have established that** ionising radiation causes...
- Low-dose responses to radiation have **generated considerable recent research interest.**
- Nanocrystalline oxide films **are attracting widespread interest** in fields such as...
- **Much research in recent years has focused on** carbon nanotubes.

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Previous and/or
current research
and contributions

What else?

Verbs used in the literature review:

- achieve, address, adopt, analyse, apply, argue, assume, attempt, calculate, categorise, claim, classify, collect, compare, conclude conduct, confirm, demonstrate, obtain, etc.

More examples

Example 1:

In recent years, significant progress has been made in understanding the mechanical behavior of high-strength aluminum alloys. **Smith et al. (2019) demonstrated** that the addition of trace elements to the alloy composition leads to improved strength and ductility, paving the way for the development of lightweight alloys with enhanced mechanical properties.

More examples

Example 2:

The work of Johnson and Brown (2017) has shed light on the effect of grain boundaries on the corrosion resistance of stainless steel alloys. **Their findings revealed** that the presence of specific alloying elements can mitigate the susceptibility to localized corrosion, offering insights for designing corrosion-resistant alloys for various applications.

More examples

Example 3:

Previous studies by Thompson et al. (2018) have focused on the influence of heat treatment parameters on the microstructure and mechanical properties of titanium-based alloys. **Their research demonstrated** that controlled cooling rates during heat treatment significantly affect the grain size distribution, leading to improved strength and fatigue resistance in these alloys.

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The gap/problem/
question/prediction

How?

1. Identifying existing knowledge gaps
2. Highlighting unresolved issues or challenges
3. Addressing practical or industrial needs

How?

1. Identifying existing knowledge gaps:

Example 1:

«While significant progress has been made in understanding the mechanical properties of titanium alloys, **there remains a knowledge gap regarding the influence of** processing parameters on the microstructural evolution during additive manufacturing techniques.»

Example 2:

«Despite extensive research on the corrosion behavior of stainless steel alloys, **there is a lack of comprehensive studies** investigating the effect of alloy composition on the pitting corrosion resistance in aggressive environments.»

How?

2. Highlighting unresolved issues or challenges:

Example 1:

«The development of high-temperature nickel-based alloys **faces challenges** in achieving a balance between creep resistance and oxidation resistance, necessitating further research into novel alloy compositions and processing techniques.»

Example 2:

«The mechanical properties and fatigue behavior of aluminum alloys have been extensively studied, but the understanding of their environmental fatigue performance in corrosive environments **remains limited, calling for detailed investigations** in this area.»

How?

3. Addressing practical or industrial needs:

Example 1:

«With the increasing demand for lightweight materials in the automotive industry, there is **a pressing need** to develop magnesium alloys with improved ductility and corrosion resistance **for structural applications.**»

Example 2:

«**The aerospace industry requires** high-strength alloys with excellent fatigue resistance **for critical components.** However, the lack of understanding regarding the influence of alloying elements on the fatigue behavior of titanium alloys hinders their optimal utilization in aerospace applications.»

What else?

- **Phrases:** few studies have..., little evidence is available, little work has been done, more work is needed, there is growing concern
- **Adjectives:** impractical, improbable, inaccurate, inadequate, incomplete, inconclusive, inconsistent

What else?

- **Nouns:** (the) absence of, (an) alternative approach, (a) challenge, (a) defect, (a) drawback, (an) error, (a) flaw, (a) lack, (a) limitation
- **Conjunctions:** however, although, despite

More examples

Example 1:

«**While** considerable progress has been made in understanding the corrosion behavior of stainless steel alloys, **there is still a lack of** comprehensive investigations into the localized corrosion resistance of these alloys in aggressive chloride-containing environments. The pitting and crevice corrosion susceptibility of stainless steel alloys remains a critical challenge, requiring further research to develop effective corrosion mitigation strategies.»

More examples

Example 2:

«**Although** nickel-based superalloys have been extensively studied for high-temperature applications, **there is a research gap** regarding their mechanical behavior under combined mechanical and thermal loading conditions. The interaction between mechanical loading and thermal gradients in these alloys remains poorly understood, necessitating further investigations to ensure their reliable performance in extreme operating environments.»

More examples

Example 3:

«**Despite** significant advancements in the development of titanium alloys, **there is a lack of** understanding regarding the influence of microstructural features on their fatigue behavior. The role of grain size, texture, and phase distribution in the fatigue resistance of titanium alloys remains a research gap, which needs to be addressed to optimize their mechanical performance and enhance their fatigue life.»

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The present work/paper

What else?

- **Verbs:** (to) facilitate, (to) illustrate, (to) improve, (to) minimize, (to) offer, (to) propose, (to) provide, (to) reveal
- **Phrases:** (this) work, begin by/with, close attention is paid to, here, overview
- **Adjectives:** simple, straightforward, successful, valuable
- **Nouns:** aim, goal, purpose, objective

More examples

Example 1:

The present work focuses on the development of high-entropy alloys (HEAs) for structural applications. We explore the influence of varying alloy compositions on the phase stability, mechanical properties, and corrosion resistance of HEAs. Through a combination of experimental characterization and computational modeling, we aim to provide insights into the design and optimization of HEAs with desirable properties.

More examples

Example 2:

In this paper, we present a comprehensive investigation into the fatigue behavior of aluminum-lithium alloys. Our study involves a systematic analysis of the influence of microstructural features, such as grain size and precipitate distribution, on the fatigue crack initiation and propagation mechanisms. The present work aims to enhance the understanding of fatigue failure in aluminum-lithium alloys and provide guidelines for improving their fatigue resistance.

More examples

Example 3:

The focus of the present work is to evaluate

the corrosion behavior of titanium alloys in aggressive environments. We investigate the effect of various environmental factors, such as temperature, pH, and chloride concentration, on the corrosion resistance of titanium alloys.

Through electrochemical techniques and surface characterization, we aim to gain insights into the corrosion mechanisms and develop strategies for enhancing the corrosion resistance of titanium alloys.

More examples

Example 4:

In this study, we explore the potential of additive manufacturing in fabricating nickel-based superalloys with tailored microstructures and improved mechanical properties. **The present work** involves the optimization of process parameters, such as laser power and scanning speed, to achieve desired microstructural features and control the precipitation behavior in additively manufactured superalloys. The outcomes of this research have implications for the development of advanced manufacturing techniques for high-performance alloys.

Summary

- Establishing the importance of the field
- Previous and/or current research and contributions
- Locating a gap in the research
- Brief outline of the paper