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SYNTHESIS AND CHARACTERIZATION OF AL-TIB2 IN-SITU MATRIX COMPOSITES AND THEIR STUDY ON TRIBOLOGICAL AND MECHANICAL PROPERTIES

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Abstract

In-Situ matrix composite can more be expensive than other materials. It is less cost-effective for certain applications. Situ matrix composite knows the high strength-to-weight ratio. It may be prone to cracking, delimitation, or other forms of damage over time. Situ matrix composite can be more difficult in process than other materials. It is requiring for specialized requirements and expertise in the situ matrix composite. This can make it more challenging and more consuming to manufacture products using these materials. Overall, the site matrix composite typically out weights the potential side effects for many applications. High-cost situ matrix composite can be more expensive to produce than traditional materials due to the complexity of the manufacturing process and the need for specialized equipment. The manufacturing process for the situ matrix composites can be complex and difficult to control, leading to variations in the material properties. Limited design flexibility for the situ matrix composites is typically made in specific shapes. This is why, which can limit their design flexibility compared to other materials that can be easily molded or formed.

Keywords: Matrix, Aluminum, Titanium, Reinforcement, Composite, Dioxide.

1. Introduction

The Synthesis and characterization of Al-TiB2 In-situ matrix composites involve the creation of a composite material consisting of aluminum. AI as the matrix and titanium dioxide as the reinforcement phase [1]. The in-situ synthesis process involves the simultaneous formation of the matrix and the reinforcement phases within the composite material. The synthesis process involves the preparation of the starting materials and their making in the appropriate ratios [2]. The mixture of then subjected to a high-energy milling process to promote the formation of the desired composite structure. The resulting powder is then consolidated into a solid composite material using techniques. Such as hot pressing in or spark plasma sintering.

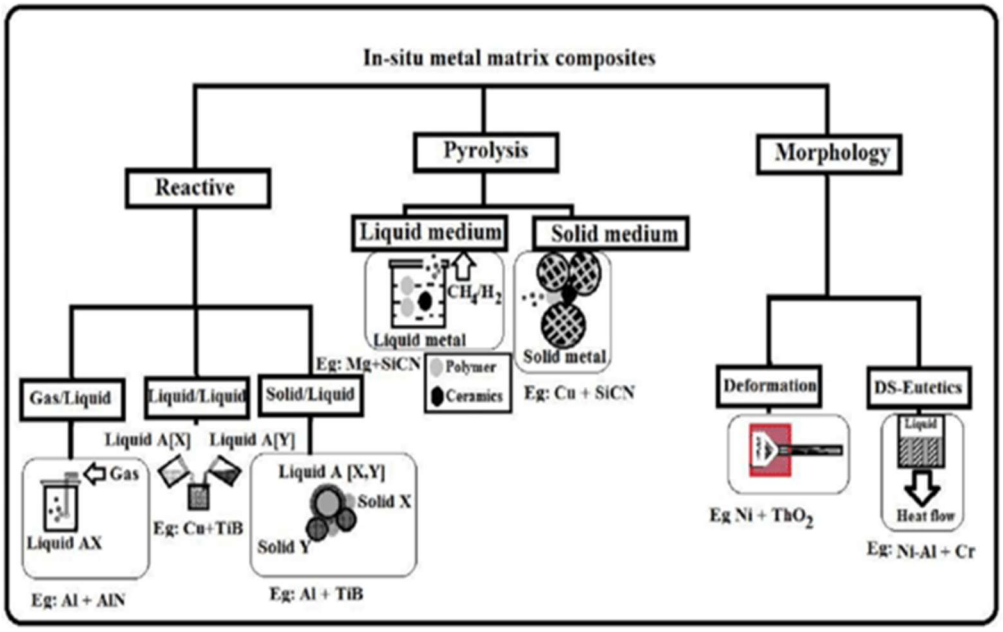

Figure 1: Situ matrix complex (Source: 1).

The characterization of Al-TiB2 In-situ matrix composites involves the analysis of the microstructure. Mechanical properties are the tribological behavior of the material [4]. The situ matrix composites techniques are such as scanning electron microscopy, x-ray diffraction, and energy dispersive spectroscopy. It can be used to analyze the microstructure and phase composition of the composite material. Mechanical testing such as hardness, tensile and compressive strength can be performed in determine the mechanical properties of the composite material. The study of tribe-logical and mechanical properties is the Ai Tib2 in situ matrix [6]. It can composite of help in understanding the behavior of the material under different loading and environmental conditions.

2. Objectives

- To composite an aluminum metal of with a high strength and high specific stiffness
- To use in saving weight for long-term application in the Al-TiB2 In-situ matrix composites
- To the use of side effects in Al-TiB2 In-situ matrix composites.
- To specialized application in such areas as cutting tools, wear-resistant of coatings, crucibles, and neutron absorbers-resistant armor.
- To use vapor coating aluminum for the evaporate boat.
- To analyze the disadvantage of the use of Al-TiB2 In-situ matrix composites.
- To use the structural titanium metal for the increase of oxidation resistance.

3. Methodology

In situ, matrix composites are formed by the creation of a metal matrix with a ceramic reinforcement material. In the case of AI-TiB2 in situ matrix composites aluminum is the metal matrix and titanium dioxide [8]. It is the ceramic reinforcement material in the AI-TiB2 in situ matrix composition. The synthesis of AI TiB2 in the matrix composite involves the following

steps. The preparation of TiB2 powder is then synthesized by a reaction between titanium and boron in a furnace under an inert atmosphere.

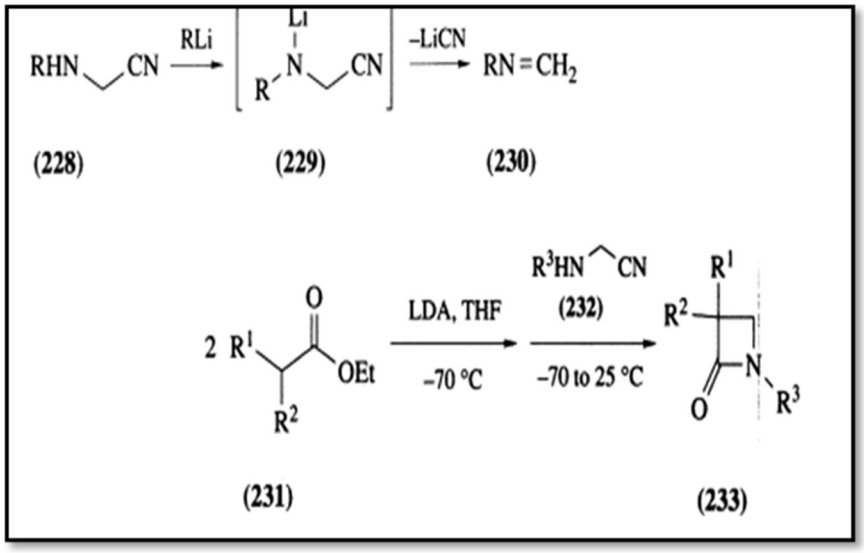

Figure 2: Composite of situ matrix complex (Source: 5).

The Matrix of the TiB2 powder is with molten aluminum. The TiB2 powder is mixed with molten aluminum to form a homogeneous mixture. In the reaction between TiB2 and molten aluminum, the mixture was heated to a temperature above the melting point of the aluminum [11]. This reaction occurs between TiB2 and aluminum to form AI. TiB2 situ matrix composites are the casting of the composites in a desired shape. The characteristics of AI TiB2 composites are followed in such techniques. Scanning electronic microscopy is used to observe the microstructure of the composites [12]. X-ray diffraction is used to identify the phases present in the composites. Transmission electron is used in the study of the crystal structure and morphology of the composites. Hardness and wear tests are performed to evaluate the mechanical and tribological properties of the composites.

4. Composite an aluminum metal a with high strength and high specific stiffness

Composite material made with the aluminum matrix can offer superior properties compared to pure aluminum. One example is aluminum reinforced with ceramic particles or fibers [9]. This is the can strength, stiffness, and wear resistance of the material. Other types of composites include aluminum reinforced with carbon fibers, glass fibers, or other materials such as titanium. These composites can also improve the mechanical properties of aluminum [12]. Such as strength, durability, and resistance to corrosion. Aluminum matrix composite can be manufactured using various techniques. Such as casting, powder metallurgy, and infiltration.

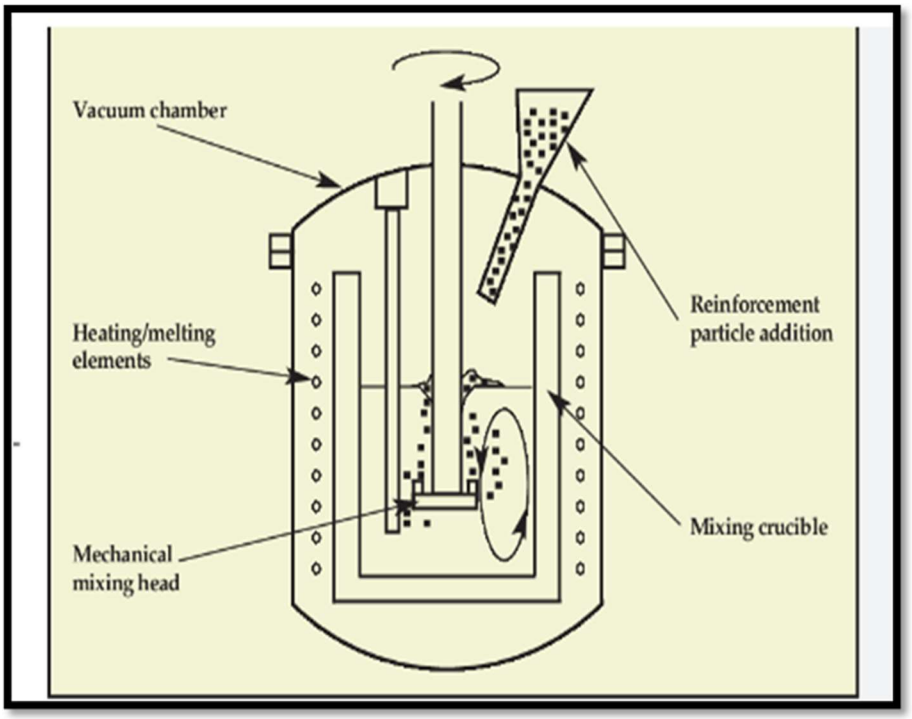

Figure 3: Composite of aluminum metal (Source: 9).

The specific manufacturing process used depends on the desired properties and the intended applications of the composite materials. Overall aluminum matrixes composites are a promising class of materials that can be offered to improve performance. There is various industry such as aerospace, automobile, and electronics in the situ matrix complex [15]. Aluminum metal is a chemical element with the symbol of AI and its atomic number is 13. It is a lightweight, silvery-white, soft, ductile metal [12]. However, pure aluminum is not commonly used in construction or other applications due to its low strength and hardness. Instead, composite materials made of aluminum are often used to provide strength and durability. One popular composite material made of aluminum is an aluminum composite panel, which is used extensively in construction [14]. In industry aluminum is lightweight, durable, and fire resistance properties.

5. Use the side effects in Al- TiB2 in-situ matrix composites.

Situ matrix composite is a type of composite material made by combining a matrix material. Such as epoxy or thermoplastic with reinforced fibers. The materials used in the situ matrix composites such as resin and fibers can release hazardous chemicals [12]. During the manufacturing process or when the composite is damaged.

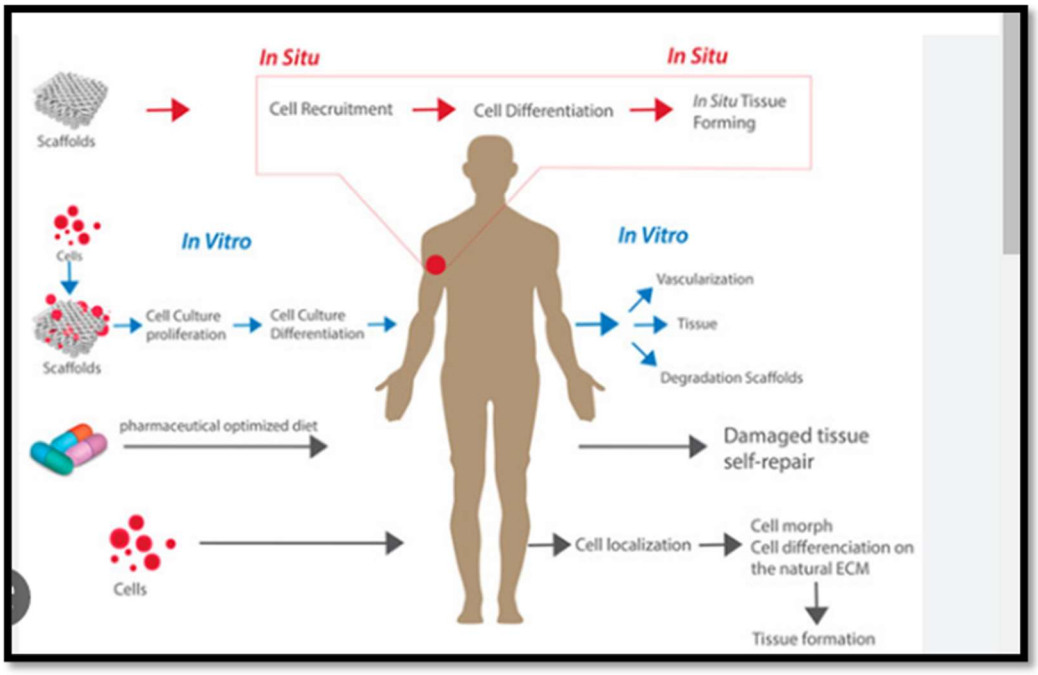

Figure 3: Side effect on situ matrix composite in the human body (Source: 12).

These can pose a health risk to the workers who handle the materials or people who meet it. The production of the situ matrix composite can have an environmental impact due to the use of non-renewable resources and the release of pollutants into the air and water.

6. Disadvantage of the use of al-tib2 in-situ matrix composites.

situ matrix composite has several advantages, including a high strength-to-weight ratio, corrosion resistance, and low thermal expansion coefficient. However, there are also some disadvantages associated with their use. One major advantage is their high-cost use of a situ matrix [8]. Situ matrix composite involves complex and specialized techniques, which can drive up the cost of production. Additionally, the cost of raw materials used in the production of the situ matrix complex. The composites of situ matrix can be expensive, particularly advanced materials such as ceramic matrix composites [7]. Another advantage is their susceptibility to damage from impact and mechanical stresses. While situ matrix composites are strong and stiff.

Synthesis method	Filler content	Advantages	Disadvantages
Spray winding	50-80 wt%	-Large scale production -Good alignment	Relatively complex apparatus
Shear press	60-70 wt%	Good alignment	Small scale production
Capillary rise infiltration	40-60 wt%	Simple apparatus	Limited to thermoplastic polymer
In-situ	5-70 wt%	-Polymerisation and	Limited to certain type

Figure 4: Advantages and disadvantages of situ matrix composite (Source: 15).

They can be brittle and prone to cracking or fracture when subjected to impact and high stresses [11]. This can limit their high use in applications where they may be exposed to such conditions. Furthermore, the properties of situ matrix composite can also be affected by temperature and environmental conditions.

7. Vapor coating use of aluminum.

Vapor coating is also known as physical vapor deposition. A thin film is deposited on a substrate material by evaporating a solid metal or alloy in a vacuumed chamber [5] in proceeds. Aluminum is commonly used as a material for vapor coating due to its unique properties. Such as being lightweight, corposant resistance, and having a high thermal conductivity. Aluminum vapor coating is often used in various industries, including aerospace, Automobile, and electronic industry [9]. Aluminum-coated components are used in spacecraft and satellite applications due to their ability to withstand harsh environments and extreme temperatures.

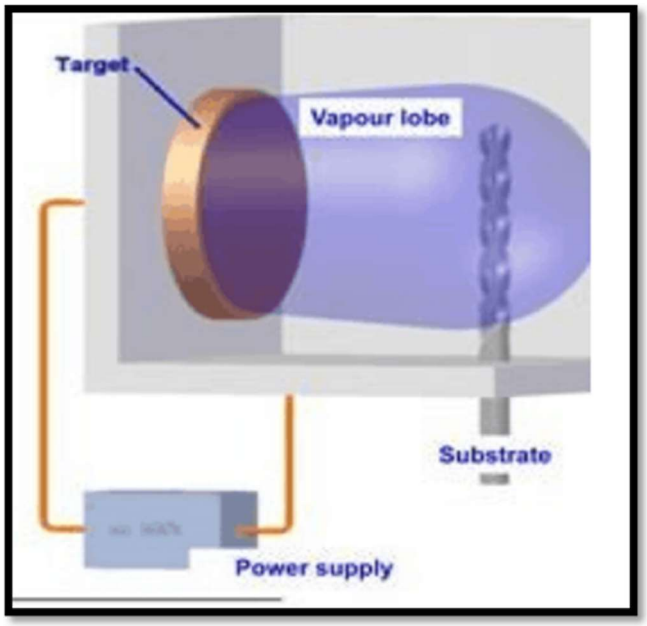

Figure 5: Vapor coating of aluminum (Source: 9).

In the automobile industry aluminum, vapor coating is used on engine components. Such as pistons and cylinders are heads to improve their wear resistance and durability. In the electronics industry aluminum, coated components are used in electronic devices. Such as smartphones and laptops to improve their thermal management and reduce heat buildup [8]. Overall vapor coating of aluminum is a versatile process that can be used to improve the performance and durability of various materials in a range of industries.

8. Problem statement.

Situ matrix composites are a type of composite material that consists of a ceramic or material reinforce with fabrics and particles. These components offer several problems over conventional materials [15]. It is including high materials, stiffness, and wear resistance. It is as well as good for thermal and chemical resistance.

9. Conclusion.

The properties of the site matrix composites depend on the type and volume. The fraction of the reinforcement of materials is the properties of the matrix material. Generally, these composites exhibit superior mechanical, thermal, and chemical properties compared to their constituent material. The fabrication situ composite can be complex. It is often involving multiple steps such as infiltration, sintering, and hot pressing. However, new processing such as additive manufacturing and infiltration casting has made the process easier, simpler, and most cost-effective.

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