FABRICATED TITANIUM ALUMINUM ALLOY AND A METHOD

IITM Technology Available for Licensing

Problem Statement

- High-strength aluminum alloys like Al 2024 are widely used in aerospace and automotive industries but face challenges in additive manufacturing, such as cracking susceptibility and a narrow processing window.
- Prior attempts to improve these alloys using grain refiners like zirconium (Zr) have shown success in refining grain size but negatively impact ductility, making them unsuitable for aerospace applications.
- There is a pressing need to develop a titanium-modified aluminum alloy through additive manufacturing that is crack-free and offers superior fracture toughness compared to wrought alloys.

Technology

- The present invention provides **a method to develop a fabricated titanium modified aluminum alloy** comprising the steps of:

(a) • **providing an aluminum alloy in powder form;**

(b) • **adding titanium as a grain refining agent to the aluminum alloy of step (a) to obtain a titanium modified aluminum alloy, wherein titanium has a weight percentage in the range of 1.9 to 2.5 %;**

(c) • **depositing layers of the titanium modified aluminum alloy on a substrate using a selective laser melting method (SLM) followed by scanning the layers of the titanium modified aluminum alloy;**

(d) • **performing solution heat treatment of the titanium modified aluminum alloy of step (c) in a vacuum furnace at temperature in the range of 470°C and 500°C for a time period in the range of 45 minutes to 1.5 hours; (refer Fig. 1)**

Intellectual Property

- IITM IDF Ref**. 2424**
- **IN 445960 - Patent Granted**

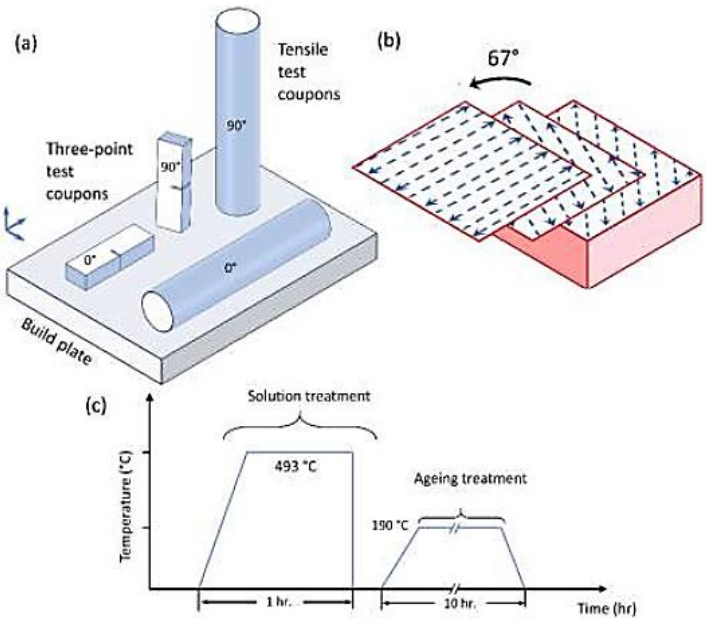

FIG.1. illustrate (a) The orientation of the as-built sample with respect to the built plate (b) Scanning strategy used in the additive manufacturing; (c) Heat treatment procedure.

Technology Category/ Market

Category - Additive manufacturing
Applications - Automobiles, additive manufacturing.
Industry - Aerospace, Automotives
Market- The global additive manufacturing market size was valued and is expected to grow at a **CAGR of 20.8%** from 2022 to 2030.

TRL (Technology Readiness Level)

TRL - 4: Technology validated in lab scale.

Research Lab

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Technology (Contd.)

(e)

• quenching the heat treated titanium modified aluminum alloy of step c); and (f) subjecting the heat treated titanium modified aluminum alloy of step (d) to an aging treatment at 180 – 200°C for 9-11 hours to develop a fabricated titanium modified aluminum alloy, wherein depositing layers of the titanium modified aluminum alloy on the substrate is done horizontally to loading direction (LD).

Key Features / Value Proposition

1. Enhanced Fracture Toughness:
The method offers a substantial improvement in fracture toughness compared to conventional wrought Al 2024 (Fig. 2), making the fabricated titanium modified aluminum alloy more durable and reliable.

2. Crack-Free Manufacturing:
The developed alloy is produced using a selective laser melting (SLM) method that minimizes cracking susceptibility.

3. Titanium Grain Refining Agent:
By adding titanium as a grain refining agent, the alloy benefits from improved microstructure and performance, with titanium content carefully controlled between 1.9% to 2.5%.

4. Precise Heat Treatment:
The method includes a well-controlled solution heat treatment and aging process, carried out in a vacuum furnace, optimizing the alloy's mechanical properties.

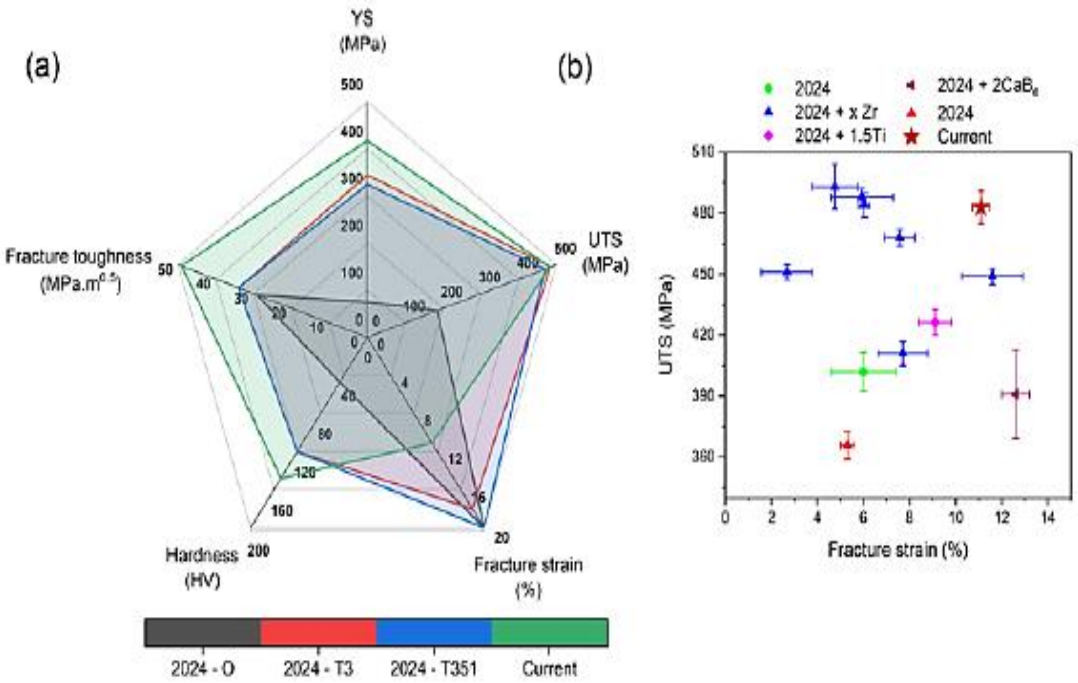

FIG. 2. illustrate comparison of mechanical properties of the (a) Conventional wrought 2024 alloy and (b) Fabricated titanium modified aluminium alloy (titanium SLMed Al 2024 alloy).

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