METHOD FOR IMPROVING THE TRIBOLOGICAL PROPERTIES OF TITANIUM SUBSTRATE

IITM Technology Available for Licensing

PROBLEM STATEMENT

- Titanium & its alloys have proven to be indispensable in various industry fields owing to their exceptional properties related to their lightweight nature, high strength and biocompatibility.
- However, **poor abrasion resistance** is considered one of the major issues that cause failure of the industrial components made up of titanium and its alloys.
- Therefore, suitable **surface modification** or **coating techniques** have been utilized to improve the wear-resistance property of the underlying titanium metal substrate. However, surface modifications such as thermal oxidation, plasma-based treatments etc. result in surface defects that restrict their application scope.
- Thus, this study focusses on producing protective coatings that have little impact on the physical properties of the metal substrate.
- Current, technology addressed above problem statement through patented Method/Process

TECHNOLOGY CATEGORY/ MARKET

Technology: pure titanium substrate
Industry: Military, Aerospace, Petrochemical, Medical including others;
Applications: Aerospace, Marine, Automotive Manufacturing, Surgery & Dentistry, Jewelry making, Racing Sports, and Aquarium,
Market: The global titanium market was valued at $24.7 billion in 2021, projected to reach **$33.5 billion** by **2026**, growing at a **CAGR** of **6.3%** from **2021** to **2026**.

TECHNOLOGY

- Patent literature describe about a method for improving **tribological properties of a titanium substrate** through **electrophoretic deposition (EPD) of graphene coatings,** wherein the features of the invention are stated herein:

1. Said titanium substrate is a commercially **pure titanium substrate**;
2. Said commercially pure titanium substrate is coated with **graphene nanoplatelets**;
3. The EPD suspension comprises of **graphene nanoplatelets, magnesium nitrate hexahydrate** (in a ratio of **1:1)** as a surface charging agent, and isopropyl alcohol as a liquid suspension medium.
4. Said electrophoretic deposition is **cathodic electrophoretic deposition**.

The process of obtaining **titanium substrate with improved tribological properties** are depicted in the figures.

KEY FEATURES / VALUE PROPOSITION

- ***Technical Perspective:*** Claimed Patent provides graphene coated titanium substrate which possesses **reduced coefficient of friction (COF)& specific wear rate** as compared to the uncoated commercially pure titanium substrate. The COF of uncoated titanium substrate was reduced by 60% to 90% due to graphene coatings.
- ***Industrial Perspective:*** Patented process is an **efficient method** & **cost-effective** to obtain **enhanced lubricating & wear resistance properties** of uncoated titanium substrate.

INTELLECTUAL PROPERTY

IITM ID F Ref. 2237;
IN Patent No: 428881 (Granted)

TRL (TECHNOLOGY READINESS LEVEL)

TRL- 4, Proof of Concept ready & validated

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Images

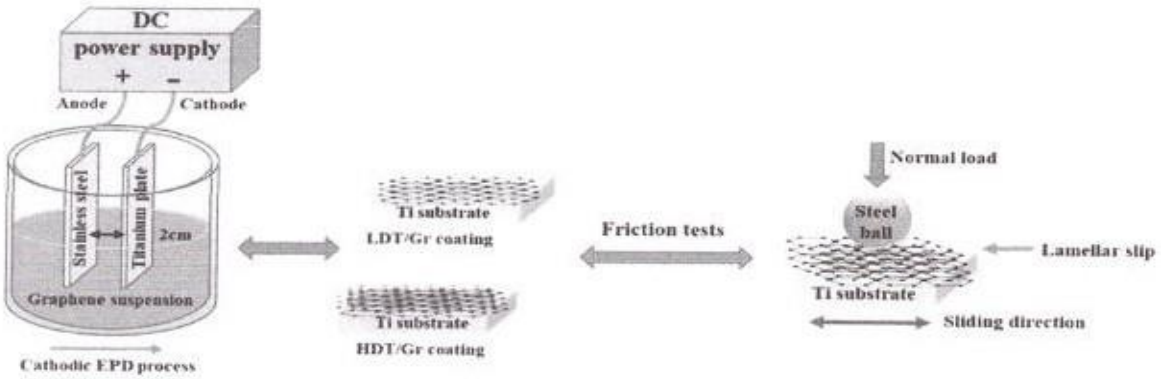
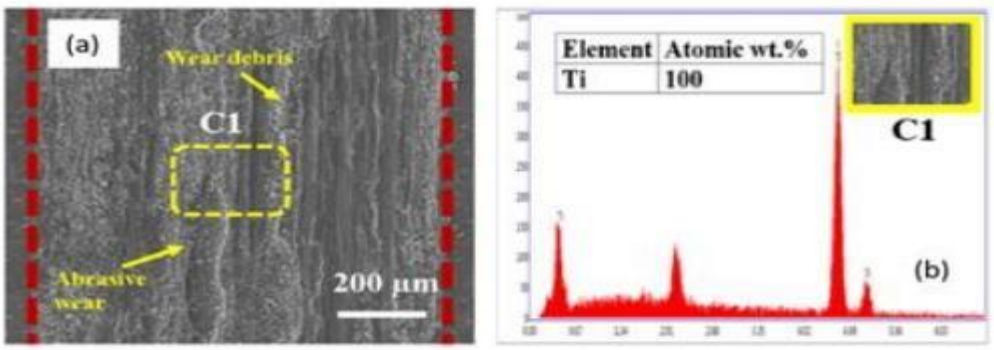


Fig. 1: Illustrates a schematic representation of preparation of graphene coating using EPD method & tribiological testing of graphene-coated samples



Figs. 2a Illustrates the surface morphology of wear track after wear tests conducted on commercially pure titanium substrate (bare) and its corresponding EDX analysis (2b)

Fig. 3a Illustrates the cross-sectional morphology of titanium substrate coated with graphene and magnesium nitrate hexahydrate & HDT; Fig.3b shows 3D surface topography of titanium substrate coated with graphene and magnesium nitrate hexahydrate & HDT

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