

E01-1916 - *(Invited)* Than Superficial: Exploiting Anodic Oxidation for Innovative Jewelry through Electrochemical Engineering

📅 Wednesday, 9 October 2024

🕒 0800 - 0840

📍 Room 304A (Level 3, Hawaii Convention Center)

Abstract

Anodic oxidation of titanium is an advanced electrochemical technique that significantly enhances titanium surfaces by inducing controlled oxidation through anodic polarization in an electrolytic solution. This process results in the formation of a durable titanium dioxide (TiO₂) layer. The unique properties imparted to titanium, such as improved corrosion resistance, biocompatibility, and aesthetic appeal, render it invaluable across diverse sectors including aerospace, medical, renewable energy, consumer electronics, architecture, industrial design, and automotive.

This presentation will explore specific applications of anodized titanium, emphasizing both its functional and decorative attributes. A particularly intriguing feature is the interference colors of anodized titanium, which demonstrate dynamic interactions with light. These properties are especially beneficial for use in architecture, design, visual communication, and fashion, where the anodized titanium surface offers a versatile palette for creating a spectrum of precisely controlled colors.

In the field of jewelry design, where artisan craftsmanship intersects with industrial technology, titanium stands out among semi-noble metals for its technical, advanced, and premium qualities. Its capacity for coloration through electrochemical treatments makes it particularly attractive for design applications. This research focuses on the application of anodic oxidation in the prototyping of titanium jewelry, aiming to enhance these pieces with unique finishes and iridescent surface colors. The integration of findings from experimental tests conducted in a laboratory setting with jewelry design concepts showcases how engineering processes such as additive manufacturing, mechanical finishing, and electrochemical techniques can be successfully applied to the art of jewelry making. This fusion of technology and craftsmanship opens up new avenues for innovation in jewelry design.

The nanostructured oxide film that forms on titanium through anodic oxidation can produce iridescent and attractive colors on the metal surface due to interference phenomena. This aspect has been extensively explored in the artistic pieces of Professor Pietro Pedferri, who developed both patented techniques and artistic methods to intensify the iridescent colors on titanium, making them usable in art. His work is well known in both scientific and artistic fields for utilizing this special property of titanium to create countless art works.

The choice of titanium is particularly advantageous for creating large, voluminous jewelry pieces, where its lightness and high mechanical resistance make the jewelry wearable. Moreover, the ability to achieve iridescent colors by merely increasing the thickness of the naturally occurring oxide layer makes titanium a very interesting material for jewelry design. The anodizing process has been carefully developed, with particular attention to the composition and characteristics of the surfaces produced, optimizing the anodic coloring of the material.

Additionally, metalworking techniques typically used in engineering applications have been successfully transferred to jewelry design. This includes the use of additive manufacturing and mechanical finishing techniques that have been adapted to meet the specific requirements of jewelry manufacturing, allowing for the production of intricate and precisely designed pieces. The application of these techniques ensures that the jewelry not only has increased aesthetic value but is also resistant to corrosion and biocompatible, which is critical for items in direct contact with skin.

Overall, the application of anodic oxidation of titanium in jewelry design exemplifies how advanced manufacturing techniques can be integrated into traditional crafts to produce innovative and contemporary designs. The ability to manipulate the surface properties of titanium through anodic oxidation offers a wide range of possibilities for creating jewelry that is both beautiful and functional, meeting the demands of modern consumers who seek distinctive and high-quality products.

This study was carried out within the MICS (Made in Italy – Circular and Sustainable) Extended Partnership and received funding from the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.3 – D.D. 1551.11-10-2022, PE00000004).



Corresponding Author



MariaPia Pedferri
Politecnico di Milano

Authors



Maria Vittoria Diamanti
Politecnico di Milano



Barbara Del Curto
Politecnico di Milano

View Related
