



Research Highlights

जैव-सिरेमिक के पिको सेकंड लेजर टेक्सचरिंग एवं स्पंद लेजर निक्षेपण के माध्यम से Ti6Al4V का बहु-कार्यात्मक सतह संशोधन
उन्नत कार्यात्मकता के लिए **Ti6Al4V** की लेजर सतह अभियांत्रिकी

Multifunctional Surface Modification of Ti6Al4V through Pico-second Laser Texturing & Pulsed Laser Deposition of Bio-Ceramics *Laser Surface Engineering of Ti6Al4V for Enhanced Functionality*

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Ti64 (Ti6Al4V) is widely used for orthopedic, dental, and cardiovascular implants owing to its high strength, excellent biocompatibility, and corrosion resistance. However, its bio-inert surface limits direct tissue bonding and effective osseointegration, potentially compromising long-term implant stability. Since tissue integration is strongly governed by surface properties, controlled surface engineering offers an effective approach to enhance bioactivity, mechanical interlocking, and implant longevity [1-2]. In our newly published study, we report synergistic effect of two-step surface improvement of Ti6Al4V by picosecond laser surface texturing (LST) followed by pulsed laser deposition (PLD) of two types of ceramics, bio-active 45S5 glass and bio-inert zirconia. The modified hybrid surface (LST + PLD) exhibited altered topography, roughness, and wettability. Electrochemical analysis performed in simulated body fluid revealed improve-ments in corrosion resistance and impedance properties. Biological evaluation included study of U2OS osteosarcoma cells adhesion, proliferation, counts and the antibacterial efficacy of sample surface against

Bacillus gram positive bacteria. The results revealed that, the zirconia coated sample possesses maximum corrosion potential (0.03 V), minimum corrosion current density (1.02×10^{-6} A/cm²) and almost six-fold improvement in antibacterial behavior. In contrast, bio-glass coating exhibited highest cell density (~ 112 cells per 4 mm²) compared to other samples. These finding suggested that, the hybrid approach of laser texturing with bio ceramics coating can synergistically improve functionality of Ti6Al4V, making it a promising candidate for advanced orthopedic and dental implant applications.

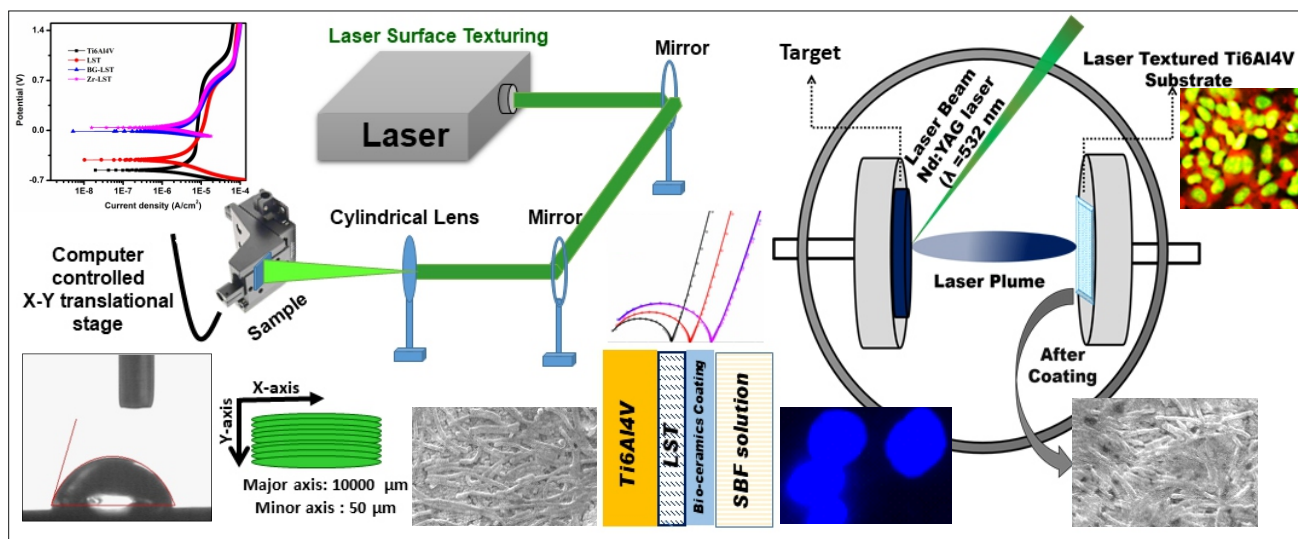
Reference:

- [1] E. Marin, A. Lanzutti, Biomedical applications of Titanium alloys a comprehensive review, Materials 25 (2023) 114.
- [2] A.S. Daniel, A.P.P. Anand, J. Naveen, T. Khan, S.H. Khahro, Advancement in biomedical implant materials—a mini review, Front. Bioeng. Biotechnol. 12 (2024) 1400918.

About the author



Dr. Sunita Kedia is currently working as a Scientific Officer/F at Laser & Plasma Technology Division, Bhabha Atomic Research Centre (BARC), Mumbai, India. Her research focuses on Laser-Material processing, Surface modified biomaterials, Bio-ceramics thin-film coating, and Selective laser sintering. She has about 50 peer-reviewed publications, with 550 citations.



Schematic representation of LST and PLD with relevant results.

Sunita Kedia, Prabha Soundharraj, Rajesh K. Chaurasia, L.V. Panicker, B.K. Sapra, J. Padma Nilaya, "Synergistic effect of picosecond laser texturing and pulsed laser deposition of bio-ceramics on Ti6Al4V performance" Optics and Laser Technology, 203 (2026) 115673.