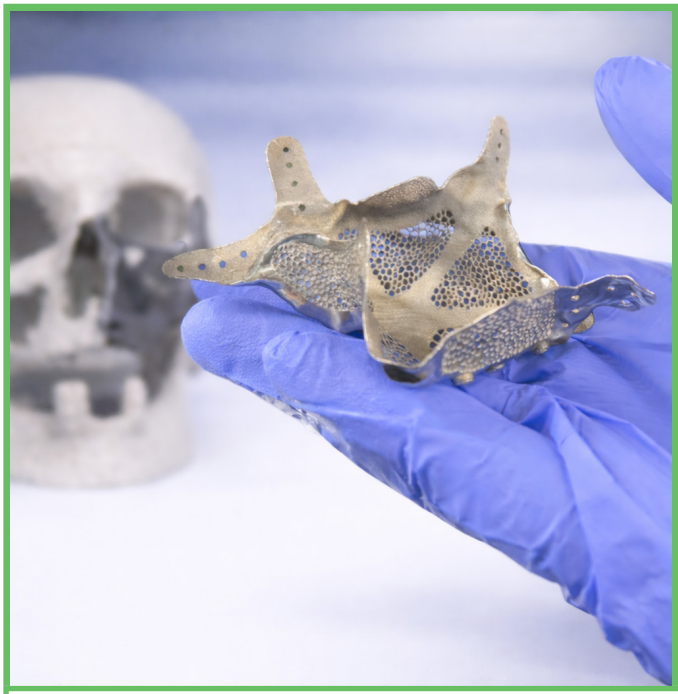
CUSTOMED - Innovative production of custom-made medical devices

Abstract:

Surface characteristics created through various surface treatment procedures play a critical role in the cleanliness and clinical performance of titanium implants. The broader aim of this project is to advance environmentally sustainable ("green") surface treatments while enabling the production of cleaner implants. The specific objectives include replacing hazardous chemicals used in etching and anodization with environmentally friendly alternatives; substituting conventional blasting particles with alternative media, such as hydroxyapatite, to prevent residual contamination of implant surfaces; and developing surface treatment procedures tailored specifically for 3D-printed implants.



Countries involved

Application sectors
Healthcare, medical devices

Research and innovation domains
Advanced manufacturing processes, Sustainable manufacturing

Total cost in M€ (millions)
0.44 M€

Starting date
01/01/2025

Duration (in months)
30 months

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RATIONALE OF THE PROJECT

Surface treatments are essential for ensuring the cleanliness, biocompatibility, and long-term clinical performance of titanum medical implants. However, current state-of-the-art surface modification processes rely heavily on hazardous chemicals for etching and anodization. Grit blasting abrasive media also poses challenges from environmental and health perspectives. In addition, conventional surface treatments are not fully compatible with the rapidly growing use of additive manufacturing for implants, leading to suboptimal surface quality and contamination risks. The project addresses these challenges by optimizing implant surface processing from both a sustainability and performance perspective. We aim to reduce the environmental footprint of implant manufacturing while improving surface cleanliness and functionality. The key challenge lies in replacing established but harmful processes with green, scalable, and industrially viable alternatives without compromising clinical outcomes or manufacturing efficiency.

TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

The project introduces significant technological innovations beyond the current state of the art by developing environmentally friendly surface treatment solutions for medical implants. These surface treatments incude acid etching and anodization. Hazardous chemicals traditionally used in etching and anodization will be replaced with green chemical alternatives. In parallel, conventional Al2O3 blasting particles will be substituted with other biocompatible media such as hydroxyapatite to eliminate surface contamination. Nowadays, Al2O3 is widely used in the surface treatment of medical implants. However, blasting particles embedded in titanium implant surfaces that are not removed in later processing can pose clinical risks. In addition, novel surface treatment protocols are designed specifically for additively manufactured implants, addressing their unique surface morphology. Combination surface treatment protocols will be adapted on a robotic cell that can reliably produce the same results with every repetition. The project will achieve cleaner, more controlled implant surfaces with improved consistency and reduced environmental impact. The resulting processes are compatible with industrial production and regulatory requirements, delivering validated surface treatment routes that enhance implant safety, performance, and sustainability.

MARKET POTENTIAL

The global medical implant market continues to grow, driven by aging population, increasing surgical volumes, and the rapid adoption of 3D-printed implants. Manufacturers face rising pressure to comply with stricter environmental and medical device regulations while trying to maintain innovation, high product quality and competitiveness. The project directly addresses these market needs by providing cleaner, greener, and regulation-ready surface treatment technologies. Consortium partners cover key positions along the value chain, including surface technology providers, implant manufacturers, and research organizations, ensuring strong market access. This positioning enables rapid industrial uptake, integration into existing manufacturing lines, and future commercialization across multiple implant sectors.

IMPACT POTENTIAL

The project is expected to deliver strong environmental, industrial, and societal impacts by reducing the use of hazardous chemicals, lowering waste generation, and improving worker safety. Cleaner implant surfaces enhance patient safety and clinical outcomes, while sustainable processing supports regulatory compliance and long-term competitiveness of European implant manufacturers. The developped solutions will have the potential to be integrated into both custom-made and serial-made titanium implant manufacturing. By enabling greener production of advanced and 3D-printed implants, the project contributes to sustainable healthcare systems and medical device innovation.