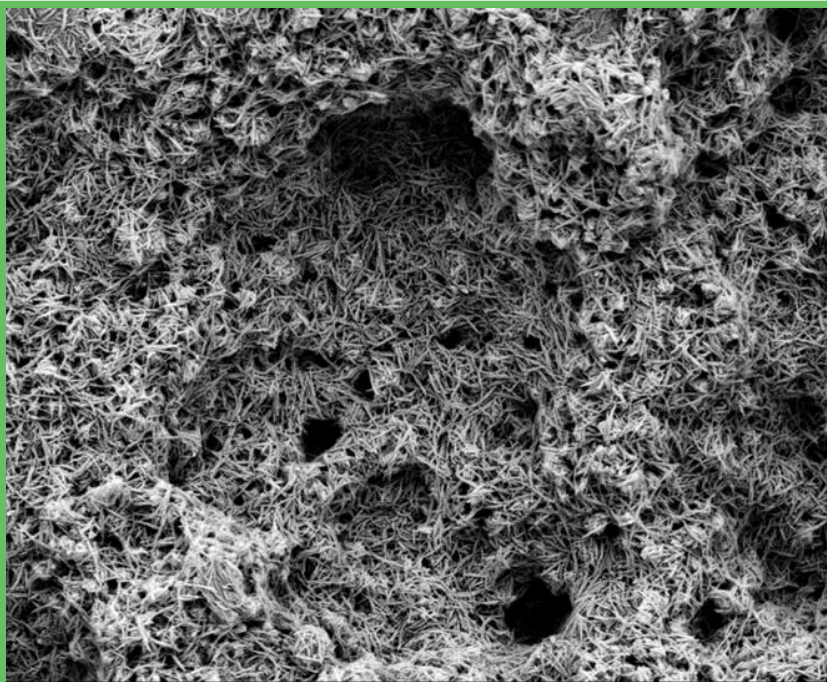


Cleaning and Activation of Implant materials by Atmospheric pressure Plasma with Integrated quality control for REliable adhesion of Nano-Hydroxy-Apatite

Abstract:

The project aims to develop unique processes and equipment for implants based on sustainable atmospheric pressure low temperature plasma, for cleaning, functionalization, and improved adhesion with Hydroxyapatite on implants made of polymeric materials, ceramic, and metals. Ensuring the process and high cleaning levels to be achieved with higher repetition rate – without damaging the initial surface materials and structures. With a process that leads to increased quality with lower costs, reduced CO2 equivalents and less waste.



Countries involved



Application sectors

Medical

Research and innovation domains

Advanced manufacturing processes, Sustainable manufacturing

Total cost in M€ (millions)

828.4 K€

Starting date

01/11/2024

Duration (in months)

24 months

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RATIONALE OF THE PROJECT

The world is facing a growing geriatric population with an increasing need of smart and safe medical implants that osseointegrate rapidly. The need of health care, a rising prevalence of chronic diseases together with growing technological advancement are drivers for the medical implant market. Implant properties required are short healing time, low cost, safe and sustainable materials and processes, with potential of being flexible and useful also for individually designed implants. Surface chemistry, cleanliness and quality control is a crucial factor for its performance in vivo, whether if it is designed to integrate to bone or into soft tissue. Even small amounts of residues from the manufacturing process can cause adverse effects, and considerable effort is needed to guarantee the highest standards of cleanliness. In the case of polymeric implant materials, some of them are typically bioinert, hydrophobic and do not osseointegrate

easily. Surface treatment to modify the surface chemistry is needed to improve the biocompatibility. The standard chemistry used for such processes is sometimes harmful to skin, complex in recycling and overall, a non-green technology. The project contributes by the development of unique processes and equipment for implants. These will be based on sustainable atmospheric pressure (AP) low temperature plasma, for cleaning, functionalization, and improved adhesion of nanosized Hydroxyapatite (HA) coatings on implants from different materials.

TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

A successful project is expected to deliver a fine cleaning and activation process with atmospheric pressure plasma treatment for improved wetting and coating adhesion. The project is aiming for a robust, sustainable, cost effective and agile production process with inline quality control for:

- Flexible and robotized process for a broad range of materials and geometries
- Improved osseointegration and reduced healing time through improved HAnano adhesion

The process will be evaluated on flat and simple 3D geometries and the effect on osseointegration in t ex vivo and in vivo biointegration tests. The development of the processes will be carried out in an interactive process where learnings from ex vivo experiments will be fed back into the atmospheric plasma process development. A demonstrator study combined with a cost and sustainability assessment is also to be conducted.

MARKET POTENTIAL

The partners would benefit from the project through newly developed processes and equipment, being able to entering new markets and sectors, expand the business within Europe and the US, reach new customers and being able to contribute to and benefit from recent trends within orthopedic and dental implants. This in a phase where the medical implant business is in a strong expansion

phase and are expecting an annual growth rate of 6,8% to 2032 through the increase in the world's growing geriatric population that is expected to reach 2.1 billion by 2050. The CAIPIRENHA project has received funding from VINNOVA and Federal Ministry for Economic Affairs and Climate Action (on the basis of a decision by the German Bundestag) through Eureka and the Clusters programme and SMART Cluster.

IMPACT POTENTIAL

Europe has a strong tradition in the medical technology industry. The project partners would benefit from the newly developed processes and equipment, being able to entering new markets and sectors, expand the business within Europe and the US, and reach new customers within orthopedic and dental implants. The society will benefit from shortened healing time, less medical care and reduced costs, resulting in shorter convalescence and reduced suffering. The project consortium also strongly believe that other branches would benefit from the developed processes. This on the basis on the flexibility, low cost, sustainable, fast, robust, easily implemented and highly cleaning effect.

