

Bone-Mimetic Mineralized Coating of Three-Dimensional Printed Thermoplastic

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ABSTRACT

A method (900) of coating a three-dimensional (3D)-printed thermoplastic scaffold (104) is disclosed. The method (800) includes a 3D-printed thermoplastic scaffold (104) is provided. Surface of the 3D-printed thermoplastic scaffold (104) is activated through an alkali treatment to produce an alkali etched 3D-printed thermoplastic scaffold (108). A low-temperature hydrothermal treatment is performed on the alkali etched 3D-printed thermoplastic scaffold (108) to deposit hydroxyapatite on the alkali etched 3D-printed thermoplastic scaffold to produce a coated 3D-printed thermoplastic scaffold (112). The HA coating, characterized by SEM and TEM analyses, reveals the formation of crystallized floral-patterned HA nanoneedles, enhancing mechanical strength and biological activity. Quantitative antibacterial assays demonstrate a significant reduction in bacterial count on HA-coated scaffolds compared to untreated controls, highlighting the bactericidal properties of the coating. These results underscore the potential of HA-coated thermoplastic scaffolds for bone tissue engineering applications, offering enhanced biocompatibility and infection resistance.

KEY APPLICATION AREAS

1. Bone Tissue Engineering.
2. Orthopedic & Reconstructive Surgery.
3. 3D-Printed Biomedical Implants.
4. Regenerative Medicine.
5. Antibacterial Biomaterials & Medical Devices.

POTENTIAL USE

- 1.Treatment of critical-size bone defects and bone regeneration.
- 2.Hydroxyapatite-coated 3D-printed scaffolds for bone graft substitutes.
- 3.Load-bearing bone scaffolds with enhanced mechanical strength.
- 4.Infection-resistant implants with antibacterial properties against E. coli and S. aureus.
- 5.Patient-specific 3D-printed orthopedic implants and tissue-engineered constructs.