Porous Nanogold/Polyurethane Scaffolds with Improved Antibiofilm, Mechanical, and Thermal Properties and with Reduced Effects on Cell Viability: A Suitable Material for Soft Tissue Applications

Tamayo L.
Acuña D.
Riveros A.L.
Kogan M.J.
Azócar M.I.
Páez M.
Leal M.
Urzúa M.
Cerda E.

The use of implants carries on a series of problems, among them infections, poor biocompatibility, high levels of cytotoxicity, and significant mechanical differences between implants and host organs that promote stress shielding effects. These problems indicate that the materials used to make implants must meet essential requirements and high standards for implantations to be successful. In this work, we present the synthesis, characterization and evaluation of the antibiofilm, mechanical, and thermal properties, and cytotoxic effect of a nanocomposite-based scaffold on polyurethane (PU) and gold nanoparticles (AuNPs) for soft tissue applications. The effect of the quantity of AuNPs on the antibacterial activity of nanocomposite scaffolds was evaluated against Staphylococcus epidermidis and Klebsiella spp., with a resulting 99.99% inhibition of both bacteria using a small quantity of nanoparticles. Cytotoxicity was evaluated with the T10 1/2 test against fibroblast cells. The results demonstrated that porous nanogold/PU scaffolds have no toxic effects on fibroblast cells to the 5 day exposition. With respect to mechanical properties, stress-strain curves showed that the compressive modulus and yield strength of PU scaffolds were significantly enhanced by AuNPs (by at least 10 times). This is due to changes in the arrangement of hard segments of PU, which
increase the stiffness of the polymer. Thermogravimetric analysis showed that the degradation onset temperature rises with an increase in the quantity of AuNPs. These properties and characteristics demonstrate that porous nanogold/PU scaffolds are suitable material for use in soft tissue implants.

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antibiofilm
biomaterials
gold nanoparticles
mechanical properties
non-cytotoxic
porous scaffolds
Bacteria
Biocompatibility
Biomaterials
Biomechanics
Cell culture
Cytotoxicity
Fiber optic sensors
Fibroblasts
Gold compounds
Gold nanoparticles
Mechanical properties
Metal nanoparticles
Nanocomposites
Strain
Stress-strain curves
Synthesis (chemical)
Porosity
Tissue Engineering
Tissue Scaffolds