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PLA based nanocomposites with titanium dioxide and silver nanoparticles and an ink for solvent-assisted 3D printing for bone tissue regeneration

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Considering that bone tissue regeneration has its limits because the body cannot regenerate large fractures spontaneously, and that cancer patients are more susceptible to bone fractures, the need for a bone tissue regeneration technology gradually grows. In order to overcome the limitations of bone grafts, polymeric scaffolds are used in this area for their biocompatibility, biodegradability and ability to create a platform for cell adhesion, proliferation and differentiation. Among the scaffolds fabrication techniques, 3D printing stands out because the structure is created layer by layer, according to a pre-determined computer model, which allows for better control of the scaffold architecture and porosity. The solvent-assisted 3D printing technique consists of direct deposition of layers of a solution made in a volatile solvent. It brings huge advances for the field of bone regeneration, for it allows direct fabrication of nanocomposites. The goal of this study is to create a PLA-based nanocomposite with silver nanoparticles and titanium dioxide (TiO_2) nanoparticles that can be used as an ink to 3D print scaffolds for bone tissue regeneration, using the solvent assist technique. The nanoparticles were used for their biocompatibility, mechanical strength and bactericide effect. Additionally, the silver nanoparticles have an anti-tumoral activity, which would allow for a treatment of the cancer responsible for weakening the bone in the first place. These nanocomposites will be prepared via solution method (PLA 20% w/w) and characterized by rheological testing, Fourier-transform infrared spectroscopy (FTIR), relaxometry with time domain nuclear magnetic resonance (NMR), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and x-ray diffraction.

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