Hydroxyapatite and Inorganic Particles Based Composition (Yeda)

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Summary

Biocompatible polymers commonly used in the orthopedic and cosmetic prosthetics, cardiovascular and dental implants and food packaging industries often suffer from poor mechanical properties and thermal stability, limited dimensionality and short shelf-life as compared to their metal comparators. Two research groups from the Weizmann Institute of Science and Tel-Aviv University, have demonstrated the Integration of inorganic tungsten sulfide nanotubes (WS2-NTs) into standard polymer solutions, without impacting viscosity. When deployed in standard fused deposition modeling processes, the reinforced polymers present uniform dispersion of the WS2-NTs, usually hard to achieve using other nanoparticles such as carbon nanotubes or graphene, and preserved crystallinity. Fabricated products are biodegradable and biocompatible, and demonstrate enhanced mechanical strength as compared to neat polymer solutions. The WS2-NTs-reinforced polymer can serve as ink for 3D printing of a range of products, including custom-designed orthopedic, cardiovascular, dental and plastic surgery implants and prostheses, and may be advantageous in the food packaging industry.

Applications

Custom-made biodegradable soft implants Biodegradable soft stents Bone engineering Scaffolds for tissue engineering.

Advantages

Improved mechanical and rheological properties Processing flexibility, compatible with 3D printing technologies Easily dispersed in the polymer solution without affecting viscosity Enhanced thermal stability Reduced material friction.

Technology's Essence

The technology developed by this group generates biodegradable and biocompatible WS2-NTs-reinforced poly(L-lactic acid) (PLLA) nanocomposites to be applied in standard 3D printing processes. When used as a feeding filament in an FDM process, melt-extruded, solvent-free WS2-NTs-PLLA nanocomposites showed preserved viscosity and proved simple to use, without requiring solvent-supported dispersion or any printing parameter adjustments. During the printing procedure, the WS2-NTs became evenly dispersed along the nanocomposite filament diameter, and crystallinity was preserved. The resulting reinforced PLA-WS2 composite demonstrated a 20%, 23%, and 35% increase in elastic modulus, yield strength and strain-at-failure, respectively, as compared to neat PLA. The toughness increased by no less than 100% and above. The researchers demonstrated this method's applicability in custom-tailored printing of prosthetic organs for dental, orthopedic and plastic surgery applications.

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