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Biodegradable load-bearing nanocomposites for controlled drug delivery and damaged bone repair

The requirement for new bone to replace or restore the function of damaged or lost bone, including cases of tumor resection, is a major clinical and socioeconomic need. Bone grafting is intended to stimulate bone healing and fill bone defects. Load-bearing ability of grafts is very important to avoid additional surgery, needed if implant fixation and fasteners are used and should be removed. One of the research strategies in last years is development of biodegradable graft substitutes. Biodegradable implantable devices should slowly degrade over time and disappear with ingrown natural bone replacing the synthetic graft. Finally no foreign material is left behind, allowing complete tissue regeneration without the risk of chronic inflammation or long term immune response and stress shielding related bone atrophy. We present a short review on processing and properties, including *in vitro* degradation, of load bearing biodegradable nanocomposites and of macroporous 3D scaffolds for bone ingrowth. Nanostructuring of biodegradable β-TCP-polymer, β-TCP-metal, Fe-Ag and Fe-Fe_2O_3 composites is achieved employing high energy attrition milling of powder blends, followed by high pressure consolidation at ambient temperature and densities close to theoretical retention of nanoscale structure. The strength of developed nanocomposites is significantly higher as compared with micronscale composites of the same or similar composition. The developed nanocomposites supported the attachment the human osteoblast cells and exhibited no signs of cytotoxicity. Interconnected system of nanopores formed during processing of nanocomposites is used for incorporation of drugs, including antibiotics and anticancer drugs and can be used for loading of bioactive molecules enhancing bone ingrowth.

Biography

Elazar Y Gutmanas has completed his PhD at the Institute of Solid State Physics, Academy of Sciences of USSR in 1970. He immigrated from the USSR and joined Technion in 1974. He investigated dislocation mobility and mechanisms of plastic deformation. He developed near-net shape processing method-cold sintering/high pressure consolidation of powders at ambient temperature and together with Prof Irena Gotman; powder immersion reaction assisted coating-PIRAC and reactive forging–processing of dense ceramic matrix composites employing pressure assisted exothermic reactions. Currently cold sintering is used for processing of load-bearing bioresorbable nanocomposites for orthopedic implants.

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