Ramification of zinc oxide doped hydroxyapatite biocomposites for the mineralization of osteoblasts

Puvala Vijayakumar Gnaneshwar[abc]; Shruthi Vathaluru Sudakaran[a]; Sivasubramanian Abisegapriyan[a]; Jositta Sherine[b]; Seeram Ramakrishna[a]; Mohd Hasbi Ab.Rahim[d]; Mashitah Mohd.Yusoff[d]; RajanJose[d]Jayarama Reddy Venugopal[ad]

[a] Centre for Nanofibers & Nanotechnology, Mechanical Engineering, Faculty of Engineering, National University of Singapore, Singapore

[b] Department of Physics and Nanotechnology, SRM University, Kattankulathur, Chennai, India

[c] Nano Science and Technology Program, Taiwan International Graduate Program, Academia Sinica and National Tsing Hua University, Taiwan

[d] Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, 26300, Gambang, Kuantan, Pahang, Malaysia

ABSTRACT

Far-flung evolution in tissue engineering enabled the development of bioactive and biodegradable materials to generate biocomposite nanofibrous scaffolds for bone repair and replacement therapies. Polymeric bioactive nanofibers are to biomimic the native extracellular matrix (ECM), delivering tremendous regenerative potentials for drug delivery and tissue engineering applications. It's been known from few decades that Zinc oxide (ZnO) nanoparticles are enhancing bone growth and providing proliferation of osteoblasts when incorporated with hydroxyapatite (HAp). We attempted to investigate the interaction between the human foetal osteoblasts (hFOB) with ZnO doped HAp incorporated biocomposite poly(L-lactic acid)-*co*-poly(ε-caprolactone) and silk fibroin (PLACL/SF) nanofibrous scaffolds for osteoblasts mineralization in bone tissue regeneration. The present study, we doped ZnO with HAp (ZnO(HAp) using the sol-gel ethanol condensation technique. The properties of PLACL/SF/ZnO(HAp) biocomposite nanofibrous scaffolds enhanced with doped and blended ZnO/HAp were characterized using Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), Contact angle and Tensile studies to determine the morphology, functionality, wettability and stability. The *in vitro* study results showed that the addition of ZnO and HAp enhances the secretion of bone mineral matrix (98%) with smaller fiber diameter (139.4 ± 27 nm) due to the presence of silk fibroin showing potential tensile properties (322.4%), and increased the proliferation of osteoblasts for bone tissue regeneration.

KEYWORDS:

Bone tissue regeneration; Zinc oxide; Hydroxyapatite; Biocomposite; Osteoblasts; Mineralization