Proc. of the Intl. Conf. on Nanotechnology for Better Living, 2016
Editors K. K. Kar, A. Shah and R. Sharma
Vol. 3, No. 1, p. 222
doi:10.3850/978-981-09-7519-7nbl16-rps-222

NBL-2016

Preparation and *in-vitro* evaluation of ceramic nanoparticles-laden polymer electrospun fibres

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Electrospinning has gained much research interest for preparing filler-loaded nanocomposite fibres for biomedical applications. Main objective of this piece of study was to assess potential of Magnesium oxide nanoparticles (MgO NPs) as bioactive filler reinforcement in polycaprolactone (PCL) polymer matrix. MgO NPs were synthesized using hydroxide precipitation sol-gel method and characterization performed using UV-Vis spectroscopy, XRD analysis, FEG-SEM/EDX, FEG-TEM, etc. PCL and MgO-PCL nano-composite fibres were prepared using electrospinning with Trifluoroethanol (TFE) solvent at 19kV voltage and 1.9 ml/hr flow rate as optimzed process parameters. Mechanical properties were determined by tensile testing (ASTM test D638 type V). Biomineralization studies were performed by soaking specimen sheets in simulated body fluid (SBF) at 37°C. *In-vitro* degradation assessment- %weight loss, pH change measurement and Mg ion release of test samples- was performed by incubating specimen in phosphate buffer saline (PBS) at 37°C under shaking conditions. *In-vitro* biocompatibility on osteoblast-like cells was demonstrated using MTT assay.

Characterization studies of magnesium oxide nanoparticles revealed diffraction peaks indexed to various crystal planes peculiar of MgO particles which were mixed polyhedral, cubical shape with size range 30-50nm. We observed significant improvement in mechanical properties (tensile strength and elastic modulus) of the as-synthesized nanocomposites as compared to neat polymer specimens due to uniform dispersion of nanofillers in polymer fibre (Figure 1A). There was a remarkable bioactivity shown by nanocomposite test samples in immersion test as indicated by formation of hydroxy apatite (HA) crystals on composite surface (Figure 1B). Degradation rate *in-vitro* was found to increase on filler addition. There was not much significant change in pH during degradation period (28 days). Release of Mg ions may be imparting its alkaline effect to neutralize acidic degradation by-products of ester hydrolysis of PCL, thus resisting in pH change. Mg ion release findings were in consonance with other degradation studies observations. Filler-loaded electrospun PCL mats showed improved biological performance in terms of cell adhesion, proliferation and differentiation.

Thus, MgO-PCL nanocomposites electrospun fibres showed significant improvement in the mechanical properties over neat polymer, in addition to good *in-vitro* bioactivity, biocompatibility and tailorable degradation kinetics, hence, it can be explored as potential scaffold material for bone-soft tissue engineering applications.

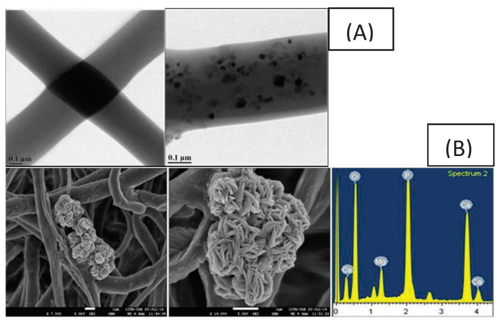

Figure 1: (A) TEM analysis of neat PCL and MgO-PCL (scale bar: 0.1 µm); (B) SEM images (low and high magnification) of HA crystals formed on electrospun scaffolds surface after 14 days SBF incubation (scale bar: 1µm) and corresponding EDS spectrum for elemental composition

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