ABSTRACT

Hydroxyapatite (HA) is the principal inorganic phase in bone. Synthetic hydroxyapatite particles, films, coatings, fibers and porous skeletons are used extensively in various biomedical applications. In this contribution, sol-gel processing and electrospinning have been used to develop a technique to produce fibrous structures. Poly(vinyl alcohol) (PVA) with an average molecular weight (M_W) between 40,500 g/mol and 155,000 g/mol was electrospun with a calcium phosphate based sol. The sol was prepared by reacting triethyl phosphite and calcium nitrate and was directly added to an aqueous solution of PVA. This mixture was electrospun at a voltage of 20 - 30 kV. The results indicate that the sol particles were distributed uniformly within the PVA fibers. This electrospun structure was calcined at 600^{o}C for 6 hr to obtain a residual inorganic, sub-micron fibrous network. The fibrous structure after electrospinning is retained after calcination. A variety of structures including solid fibers, micro-porous fibers and interconnected networks could be obtained after calcination. A bead-on-string structure was obtained after electrospinning for M_W = 40,500 g/mol. X-Ray diffraction of this fibrous structure indicated that it consisted predominantly of hydroxyapatite with an average crystal size of almost 10-30 nm. The final morphologies of the ceramic fibers were found to depend on polymer molecular weight and sol volume fraction. Average fiber diameters were on the order of 200 nm and 800 nm for molecular weight of 67,500 g/mol and 155,000 g/mol, respectively. By judiciously controlling these material and process variables, non-woven mats of sub-micron fibers with varying degrees of interconnectivity and porosity have been produced. Such novel structures can be useful in drug delivery, tissue engineering and related biomedical applications.

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