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Fabrication and Morphology Evaluation of Poly-vinyl Alcohol-Chitosan Nanofibers Prepared by Electrospinning Direct Deposition

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Electrospinning direct deposition (EDD) has been extensively studied in biomedical and tissue engineering. EDD process involves viscous and volatile polymeric solution which is loaded in syringe. High voltage is applied through the needle and then the polymer is charged trigger nanofiber formation from the charged needle to the grounded target [1]. Electrospun polymeric nanofiber it is a wide variety of potential application owing to their outstanding properties as a good processability, chemical stability, flexibility and high biocompatibility. Mechanical properties and high biocompatibility allow developing bioinspired model as adherent material useful for cell culture for tissue regenerative engineering. Copious applications of polymeric nanofibers have been studied in recent scientific works [2],[3]. Polymeric Nanofibers (PNF) are an important candidate for biomedical developments. Chitosan is a semisynthetic polymer extracted from shrimp and crab shells. Physical properties of chitosan as high solubility, mucoadhesive and biocompatibility allow designing applications oriented to medicine and regenerative fields. In this research, Polyvinyl alcohol (PVA)-chitosan (CS) electrospun nanofibers with variations of morphology and diameters were produced by electrospinning direct deposition (EDD). Experimental: 10% (w) PVA solution was prepared dissolving MPVA and HPVA with a 1:1 ratio. Furthermore, 3, 5 and 7% LVC (low viscosity chitosan) solutions were prepared. The following mixture was then prepared: VG_0 (10% PVA), VG_1 (10% PVA - 3% LVC at 4:1 ratio), VG_2 (10% PVA - 5% LVC at 4:1 ratio), VG_3 (10% PVA - 7% LVC at 4:1 ratio), VG_4 (10% PVA - 3% LVC at 3:1 ratio), VG_5 (10% PVA - 3% LVC at 2:1 ratio). The electro-spinning conditions for all samples were as follows: 10 x 10 cm aluminium substrates, with a distance Tip-collector gap of 10 cm, a Feed-rate of 0.5 mL/hr and a voltage of 15 kV. We present morphological characterization of the electrospun nanofibers analysed by Scanning Electronic Microscopy (SEM), figure 1. Sample VG_1 with the lowest chitosan concentration (Figure 1a), shows the typical fiber structure obtained by electrospinning process, diameter was measured, and size average corresponds to 150-200 nm. Increase of the Chitosan concentration promotes the production of more robust fibers. This result confirms the product obtained by X. Geng et al [4], they obtained diameters around 130-150 nm. The glass transition (Tg) and melting temperature (T_m) of the samples (each weighing 5 mg) were examined with DSC2910 from TA Instruments (at IFSC-USP), from 50 to 250 °C at a heating rate of 10 °C/min, in a nitrogen atmosphere and 50 mL. min^{-1}. As can be observed in table 1, there is a reduction in the areas of peaks of the VG_1 and VG_2 samples compared to the VG0 samples, although the Tm of the samples are practically unaffected, remaining around 220 ºC. On the other hand, figure 2 shows that the Tg of the samples undergoes a change due to chitosan, in VG_2 the Tg decreases due to the addition of hydrophilic groups. In this study, PVA-Chitosan nanofibers were successfully prepared. An important change in Tg and morphology was obtained when the Chitosan concentration was modified. From the results obtained in this research, PVA-Chitosan nanofibers are potential candidates as bioinspired scaffold system for biomedical issues [5].

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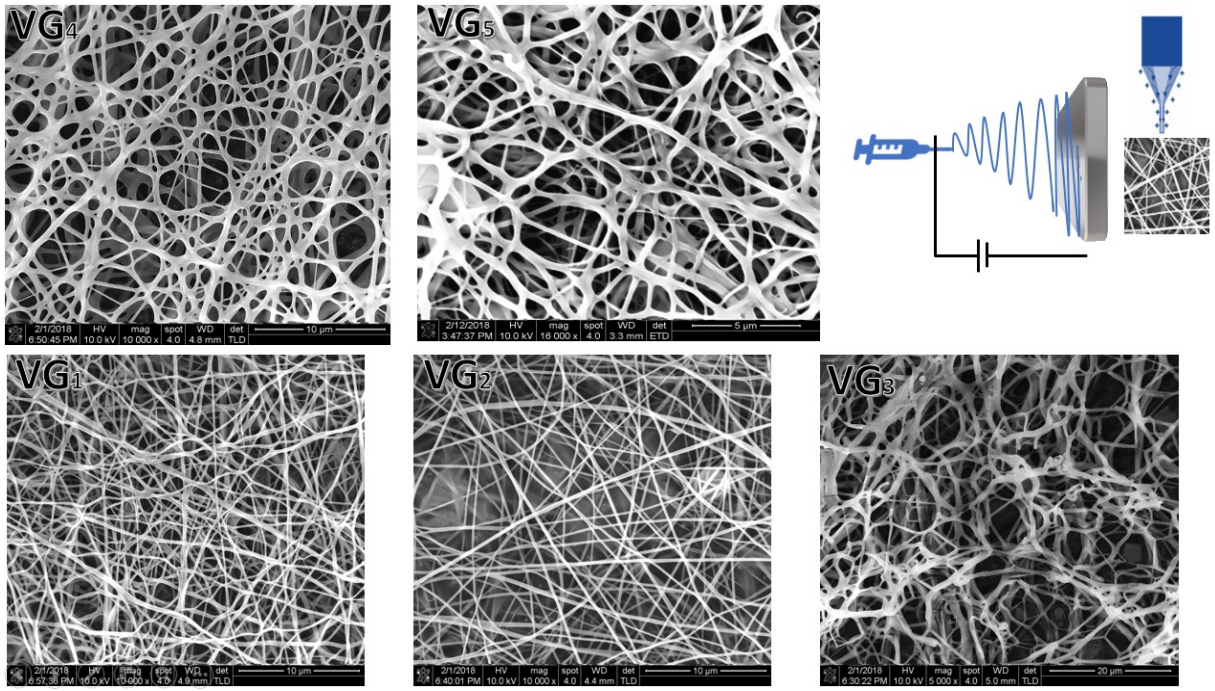

Figure 1. Scanning Electron Microscopy for samples VG_1, VG_2, VG_3, VG_4 and VG_5.

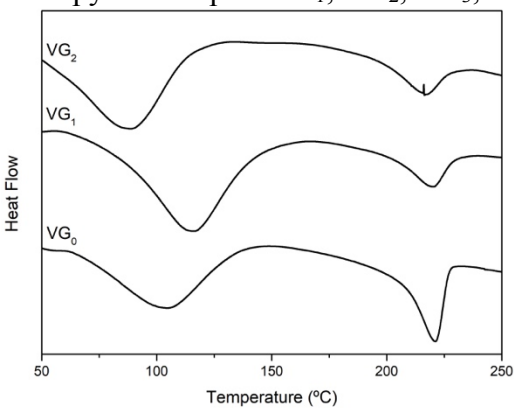

Figure 2. DSC curves for samples VG_0, VG_1, and VG_2.

Table 1. Glass transition (Tg) and melting temperature (Tm) of VG_0, VG_1, and VG_2.

Sample	Tg (ºC)	Tg-ΔH (J/g)	T_m (ºC)	T_m-ΔH (J/g)
VG_0	104.91	119.0	221.24	49.58
VG_1	115.77	189.5	220.25	26.70
VG_2	87.94	1950	216.36	31.15

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