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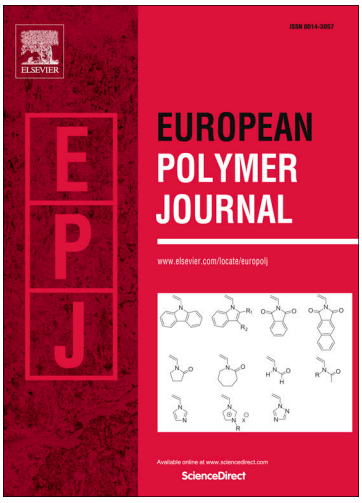

Modulation of the mechanical, physical and chemical properties of polyvinylidene fluoride scaffold via non-solvent induced phase separation process for nerve tissue engineering applications

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Modulation of the mechanical, physical and chemical properties of polyvinylidene fluoride scaffold via non-solvent induced phase separation process for nerve tissue engineering applications

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Abstract

The aim of this research was to develop microporous poly(vinylidene fluoride) (PVDF) scaffolds with an intrinsic electrical property, via the combination of non-solvent induced phase separation (NIPS) and thermal induced phase separation (TIPS) process referred as N-TIPS method. For this purpose, the effects of non-solvent incorporation (distilled water) in the solvent composition (N,N-dimethylformamide (DMF)), immersion time at coagulation bath (1, 3, 6 and 24 h) as well as coagulation bath temperature (-10, 0 and 20°C) and composition (DMF:water volume ratio= 2:6 and 6:4) on the properties of the produced scaffolds were investigated. Results confirmed that N-TIPS processing parameters had a profound effect on the morphological, mechanical, physical and thermal properties of the PVDF scaffolds. For instance, with increased bath temperature, the formation of three-dimensional bi-continuous scaffold with average pore size of 4.2±0.6 μm was achieved, whereas increased in the immersion time in coagulation bath from 1 to 24 h induced cellular morphology with a larger pore size. The formation of a relatively small pore size and uniform foam-like structure at 3h soaking in coagulation bath showed to improved mechanical properties of the scaffolds. It was also found that toughness of the scaffolds significantly promoted from 27.5±16.4 MPa (after 1 h soaking) to 155.2±25.4 MPa (after 3 h soaking). Moreover, depending on the functional parameters of N-TIPS process, β phase fraction and crystallinity of the PVDF scaffolds were in the range of 61-87% and 30-47%, respectively. Remarkably, 3 h soaking of PVDF polymer solution in coagulation bath with composition of 6:4 (D-3h-64Wscaffold) significantly