Electroactive poly(vinylidene fluoride-trifluoroethylene) membranes obtained by isothermal crystallization from solution

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Porous materials find a number of technological applications. In particular, fabrication of porous membranes made of poly(vinylidene fluoride), PVDF, and (VDF) copolymers have attracted interest of many research groups due to the potential applications as filters, as it remains inert to many harsh chemicals due to its unique chemical resistance [1,2]; as polymer electrolyte for applications in rechargeable batteries [3-5]; and in biomedical applications [6,7]. Concerning biomedical applications PVDF can be a unique material due to its piezoelectric properties that can be used in cell culture “ex vivo” under mechanical and electric excitation in tissue engineering techniques. The interest in the (VDF) copolymers is due to its resistant to γ-radiation, abrasion, demanding chemical environments, including acids, alkaline, strong oxidants, and halogens. These characteristics make this material favourable for biomedical applications. Indeed as demonstrated by Laroche et al [6] PVDF is a biocompatible polymer that can be used in a form of a suture for vascular surgery. Also Kling et al [7] reported the construction of hernia meshes made of PVDF, as an advantageous alternative to the commonly used materials, due to an improved biostability, lowered bending stiffness and a minimum tissue response. Cell culture on PVDF substrates has been also reported [8,9]. PVDF porous structures can also find important applications as smart scaffolds with enhanced functionalities [10]. PVDF scaffolds of electrospun membranes of this polymer have been reported [11].

Electroactive macroporous poly(vinylidene fluoride-trifluoroethylene) membranes have been produced by solvent evaporation at room temperature starting with a diluted solution of the co-polymer in dimethylformamide. The pore architecture consists in interconnected spherical pores (figure 1). This architecture is independent of the membrane thickness. The thickness of the membranes ranges from few microns to several hundred microns, using spin coating and evaporation in static conditions, respectively. The pore structure is explained by a spinodal decomposition of the liquid-liquid phase separation and crystallization in the copolymer rich phase (figure 2).

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References:


Figures:

Figure 1: Microphotographs of the cross section of 250µm thick P(VDF-TrFE) membrane.

Figure 2: Phase diagram for the P(VDF-TrFE)/DMF solution, the triangles corresponds to the initial volume fraction for different temperatures. The arrow represents the system evolution due to solvent evaporation.