Estimating glucose diffusivities in electrospun fibers using diffusion cell experiments and image processing

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Electrospinning is a common technique, which is applied for fabrication of scaffold for tissue engineering bioreactors. For making the scaffolds with desired morphology, a thorough understanding of the effects of the key parameters on nutrient transport in the scaffold are needed. Furthermore, it is necessary to have methods that predict the nutrient transport behavior. To address these issues partially, we prepare electro-spun polycaprolactone (PCL) scaffolds with different pore morphology by using different electrospinning duration and polymer solution flow rate. . Subsequently, the glucose diffusivities of these scaffolds imbibed in cell culture medium (CCM) and water are then measured. It is observed that the electrospinning process is reproducible and fiber-fiber space and fiber diameter are both increased with higher PCL flow rate. The fiber-fiber distance and fiber diameter are also slightly increased if the flow rate is increased by the usage of two syringes for injecting the polymer solution instead of a single cylinder.

It is well recognized however that it is not always possible to obtain results from cell culture experiments due to many reasons, which calls for other methods to predict those results. For this reason, we also attempt to predict the diffusion coefficients of glucose in CCM and water through different electro-spun scaffolds by processing scanning electronic microscope (SEM) images. For this purpose we define that the transport mechanisms in the pore space of the scaffolds are known or could be predicted. The diffusivity values obtained through images processing tool are compared to experimentally obtained values and conclusions are drawn as to whether it is possible to predict the diffusion coefficients through this method. It can be seen that results obtained from image processing are close to the experimentaly obtained results in the case of porosity as well as diffusion coefficient.