The electrospinning process has gained much attention because it is an effective method to manufacture ultra fine fibers or fibrous structures of many polymers with diameter in the range from several micrometers down to a few nanometers. Electrospinning is used as a tool for generating biopolymers scaffolds for tissue engineering [1]. Recently, many researchers in fiber and biomedical fields have been interested in fibrous protein based biopolymers, such as silk and collagen due to their unique biocompatible properties [2-3]. In our previous work [4,5], we presented the effect of some processing variables such as solution concentration and applied voltage on the morphology, diameter and diameter distribution of electrospun silk nanofibers. The electrospinning produces three dimensional scaffolds with very high porous structure. Ryu et al. [6] found that the transport of nitrogen gas through electrospun nylon 5 membranes was dependent on the fiber diameter and pore size of the membrane. Since successful applications of many nanofiber mats associated with the pore porous structure, study of the pore size and air permeability of electrospun nanofiber mats is important. The open porous structure of nanofiber mats plays an essential role in enhancing the performance of the nanofiber based materials in the biomedical applications.

In this paper, the regenerated silk fibroin dissolved in formic acid was electrospun into nanofiber mats. Structural characteristics of the as spun and methanol and ethanol treated fibers were examined using Fourier transform infrared (FTIR) spectroscopy and X-ray diffraction. Mechanical properties and air permeability of the electrospun mats were also examined. IR spectroscopy and X-ray diffractometry showed random coil conformation and amorphous structure for as-spun fibers while typical FTIR spectra and X-ray diffractograms of β-sheet crystalline structure were recorded for methanol and ethanol treated fibers. The mechanical properties of the mats were found to be dependent on fiber diameter. The mats containing fibers with smaller diameter had higher tensile strength but lower breaking strain. Methanol and ethanol treatment enhanced tensile strengths of the mats at the expenses of their breaking strain. Results of air permeability of the mats reveal that air permeability and pore size are strongly associated with diameter of the electrospun fibers.

References:

5. N. Amiraliyan, M. Nouri and M Haghighat kish, Fibers and Polymers, 10, 167 (2009)