temperature. The crystal size was calculated by Scherrer's formula. Surface morphology was studied by using SEM (Model JSM 6390V, JOEL, JAPAN).

3. Results and Discussion

3.1 FTIR Spectroscopy Analysis

The FTIR spectrum of pure spandex is shown in figure 1. The absorption peaks 964.45cm^{-1} and 671.28cm^{-1} are described to the C-H bending mode and 1361.80cm^{-1} is O-H bending. After plasma treatment the FTIR spectrum of the spandex reveals the presence of strong bonds around 638.79cm^{-1} to 3950.38cm^{-1}.

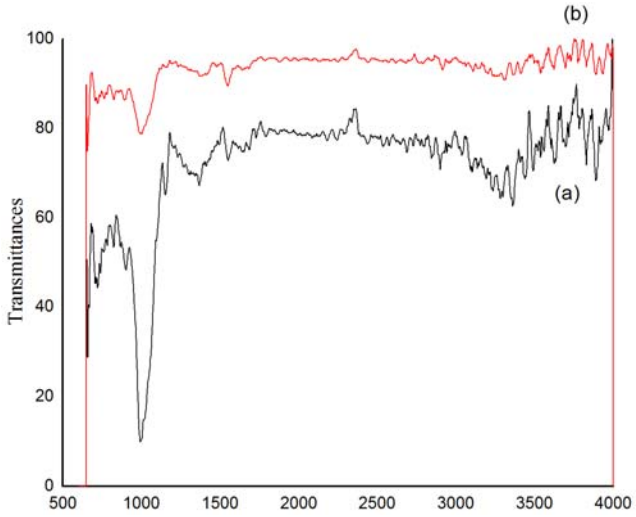


Figure 1: (a) & (b) FTIR Spectrum of Spandex Fiber

The bond around 2927.10cm^{-1} and 1313.58cm^{-1} are described to the C-H vibration mode in spandex [10]. The bond 1366.62cm^{-1} is O-H bending. The spectrum also shows that the bond at 1223.89cm^{-1} is attributed to the sacch aride structure [11]. The absorption peaks can be observed at 1102.37cm^{-1} and 683.79cm^{-1} corresponding to the C-O stretching and the –CH2-S-(C-S) stretching.

3.2 Structural analysis: XRD results

Fig-1 (a) and (b) illustrates that the x-ray diffract gram of untreated and plasma treated spandex fiber surface. The result of XRD fiber indicated that the experimental data are in good agreement. The Broadening of the peaks indicated that the particles were of nanometer scale. The particle size can be estimated from the XRD pattern using Scherrer's formula [12].

$$D=\frac{k\lambda}{\beta\cos\theta}$$

Where **D** is the crystalline size, ***k*** is a geometrical factor taken to be 0.89, λ=1.5406 Å is the X-ray wavelength, θ is the diffraction angle and β the peak width at half maximum of the most prominent peaks. Clearly, there was no significant change in the shape or position of the diffraction peaks, except that the peaks were more intense for the treated spandex fiber.

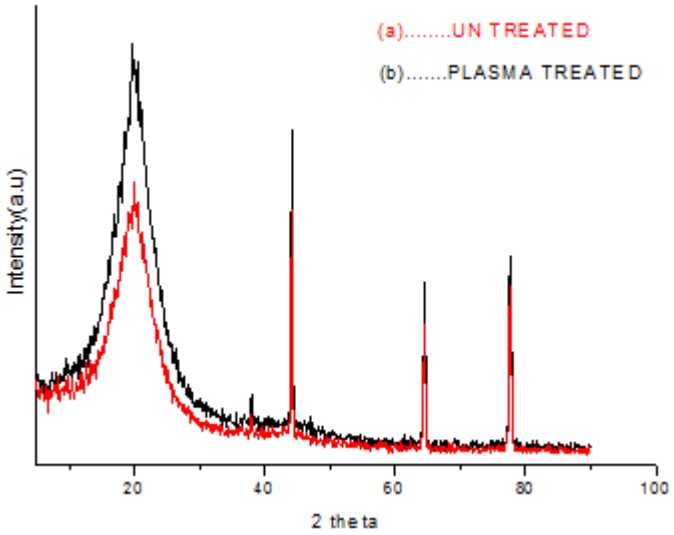


Figure 2: (a) & (b) X-Ray Diffraction of spandex fiber the crystal size (c) and the lattice spacing (d) for the crystal plane

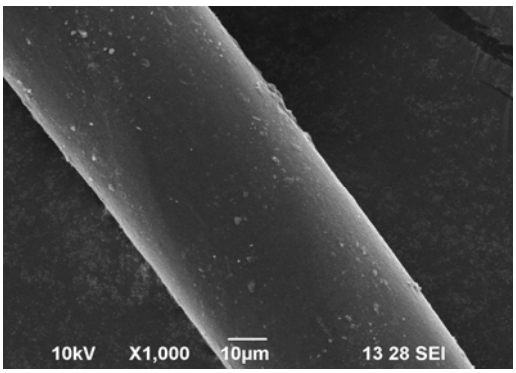
Table 2

Sample	D(A^0)	d(A^0)
Un treated	1.36133 3.055198 3.39355 3.49891	4.46220 2.05226 1.44497 1.23038
Plasma treated	1.353727 3.087769 3.39307 3.50204	4.48314 2.05518 1.44513 1.23039

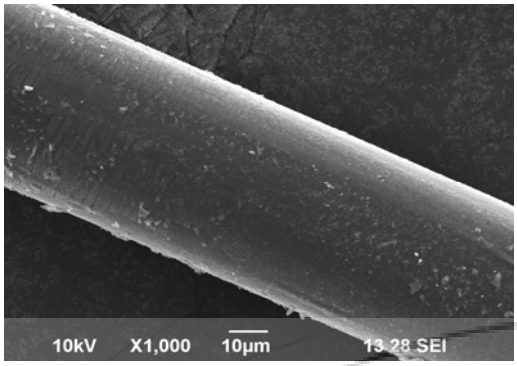
The crystal size and lattice spacing of untreated and plasma treated sample is shown in Table.2. The results higher degree of crystallinity of the spandex fiber surface after plasma treatment [9].

3.3. Surface Morphology Analysis: SEM results

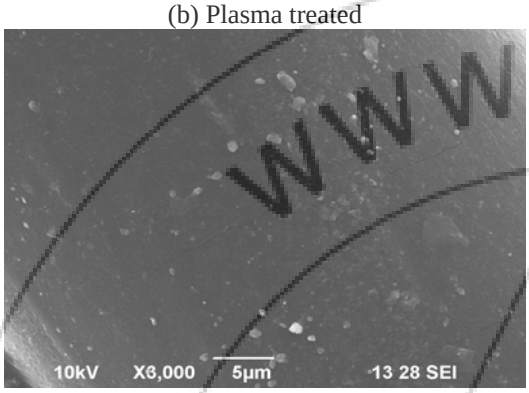
The SEM images of plasma treated and untreated spandex fiber are shown in fig (2). SEM was used to analyze the change of the surface morphology of the fibers treated by air plasma with fixed time duration of exposure. In figure (a) and (c) is untreated sample and (b) and (d) is plasma treated sample.



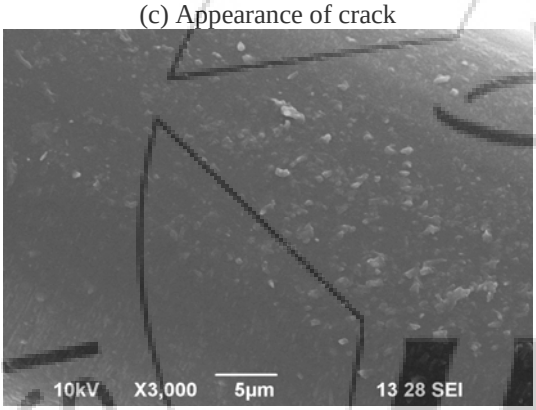
(a) Untreated



(b) Plasma treated



(c) Appearance of crack



(d) Disappearance of crack

Figure 3: (a), (b), (c), (d) SEM Micrograph of the spandex fiber

The images of the fibers illustrates the progressive change of the surface morphology with the treatment time and air flow rate. A crack appears on the surface before plasma treatment. The formation of the crack on the spandex fiber surface was modified after plasma treatment. In addition to that some spots and small fragments begin to appear. This indicates that the more obvious effects of plasma bombardment and eteting. The change in the surface morphology after plasma treatment can be explained by the localized ablation of the surface layer [13]. The etching effect on the sample surface is not noticeable when the flow rate is small. The etching effects become more obvious and the crack becomes modified.

4. Conclusion

Low pressure glow discharge plasma treatment has been used to modify the spandex fiber surface. It was found that the plasma treatment modified the surface both in crystalline and etching. The spectral analysis gave the information related to the chemical spectroscopy which showed a various bonding nature corresponding to different frequencies varied between 638.79 –3950.38cm^{-1}. The FTIR Spectra showed in absorption bonds increase in plasma treatment. XRD characterization studies shows the increase of surface roughness and crystallinity on the spandex (20D) fiber. The SEM results conform the change in surface morphology of the spandex fiber by the localized ablation of the surface layer.

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