



# PLASMA EFFECT ON THE CHEMICAL STRUCTURE OF CELLULOSE FABRIC FOR MODIFICATION OF SOME FUNCTIONAL PROPERTIES

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## ABSTRACT

The present paper describes efficiency of the low-pressure plasma process for improving of deposition process on chemical-physical activated cellulose fabric surfaces. The surface of cellulose substrates was pre-treated with O<sub>2</sub> plasma followed by acrylic acid (AAc) as monomer in plasma polymerisation process with surface of raw cotton fabrics in continuous treatment process was used (O<sub>2</sub>/AAc). AAc as monomer was applied on the fabric surface using PE-CVD process. Modifications of cellulose fibres were studied in respect to surface effects by means of SEM microscopy while the chemical effects of plasma treatment were studied using X-ray photoelectron spectroscopy. Results indicate that the surface of the cotton fibres treated with AAc was cleaner and smother with micro-fibrils visible along to fibre axis, what is in correlation with results of hydrophilic properties of O<sub>2</sub>/AAc treated samples. According results of XPS spectra, oxygen plasma certainly changed the chemical surface structure of tested cotton whereby the deposition of the AAc nano-layer on the fibre surface was enabled.

## INTRODUCTION

Plasma treatment is one of the most versatile techniques in material surface modification. It has been widely used in many applications of textile area such as improving of dyeability, wettability, soil resistance (Öktem, 2000), flame, water- and oil- repellent (Tsafack, 2007), antimicrobial efficacy (Ercegović Ražić, 2011), physical properties (Cheng-Chi, 2010) etc. It should be note that the multifunctional pronounced effect could be achieved if the plasma treatment combined with a variety of other agents, primarily a variety of organic and inorganic particles of micro- and nano-sizes. In recent years, all the more pervasive use of carboxylic acids that serve as precursors for some final processing application such as metal ions in achieving of antibacterial protection. Paper present a part of the research related to the treatment of acrylic acid applied to the raw cotton as polymerizing agent in the plasma system in a continuous treatment process whereby the dry sample was pre-treated with O<sub>2</sub> plasma. The effects were analyzed by SEM microscopy and XPS spectroscopy to determine the fibre surface and chemical changes. For testing the impact of plasma on hydrophilic properties of fabric surface, drops test was used.

## RESULTS AND CONCLUSIONS

XPS analysis for determine the changes of the fiber surface chemistry according the ratio of O/C elements content, determined on the untreated, O<sub>2</sub> and O<sub>2</sub>/AAc treated cotton. Results are presented as a general XPS and C1s high-resolution spectra in Tables 1, 2 with percentage of individual chemical elements and O/C ration, and as graphical display at Fig. 1.

Sample	%C1s	%O1s	%O/C
I- untreated cotton sample	73.91	26.09	0.35
II- cotton pretreated with O <sub>2</sub> plasma, for 5'	63.59	35.64	0.56
III- cotton treated with O <sub>2</sub> /AAc plasma, for 30'	76.07	22.76	0.30

Table 1 XPS data of general spectra for tested cotton sample and O/C ratio

According to XPS data in Table 1, it is certainly that the oxygen plasma generated more polar groups on the fiber surfaces, which was confirmed with decreased of C1s content while the content of O1s was increased. It means that a large number of oxygen polar functional groups were introduced onto the cotton fabrics surface treated with O<sub>2</sub> plasma. Contrary, at the sample treated with AAc after activation process O1s content on the cotton surface decreased (for 12.9%) and C1s content increased (for 12.5%) compared to sample treated with O<sub>2</sub> plasma. Such results are confirmed the forming the polymer nanolayer of applied AAc monomer onto the cotton fabric surface.

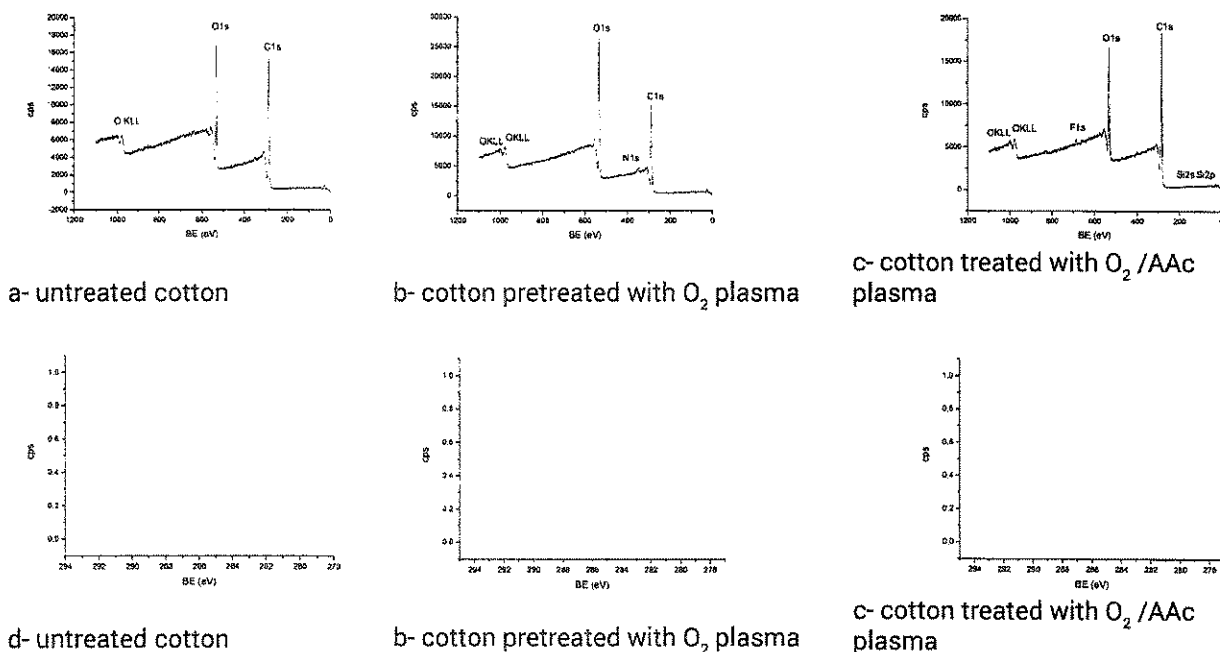


Fig. 1 Graphical display of general XPS (a-c) and C 1s high-resolution spectra (d-f)

Sample	%C-C/C-H	%C-O	%C=O/O-C-O	%O-C=O	Table 2 XPS data of high resolution C1s spectra for tested cotton sample
I- untreated cotton sample	40.9	38.4	13.8	6.9	
II- cotton pretreated with O <sub>2</sub> plasma, for 5'	22.6	39.5	26.6	11.3	
III- cotton treated with O <sub>2</sub> /AAc plasma, for 30'	26.0	58.8	0.3	15.0	

The results presented in Table 2 indicate on some carboxyls and carbonyls groups were generated onto the cotton surface, which play important role of hydrophilic effect decreased.

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