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Mechanical Property and Anti-Felting Property of Wool Fabric Treated with Low-Temperature Plasma

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Abstract: The radio-frequency low-temperature plasma treatment on wool has been recognized as an attractive process alternative to Kroy-Hercosett treatment using chlorine, because the former process is based on an eco-friendly one. However, even now the relationship between the anti-felting effect during the repetitive machine washing and the plasma treatment on wool has not been clarified. Plasma-treated wool is considered to have one distinctive feature of so-called stiff handle.

Mechanical properties of untreated fabric and plasma-treated fabric were compared for four kinds of typical wool fabrics of which textile structures are different. As the result, it was clear that rigidity and hysteresis of bending and shearing properties increased greatly by the treatment, especially for the values of 2HB and 2HG5 of KES[1]. The intensity of drawing-out a yarn from woven fabric increased greatly by the treatment. The values of 2HB, 2HG5 and the intensity of drawing out strength increased also in the conditions of high moisture regain. Further more, high correlation was found between the change of those mechanical parameters and anti-felting effect. When plasmatreatment is carried out to a wool fabric, the surface will be oxidized strongly and about 36-50 nm of the outermost surface of wool fiber is shaved off, then, all the epicuticle layer and one-third of A-layer of wool fiber are lost. It is supposed that A-layer comes out to the surface and becomes hydrophilic by the measurement of weight loss rate. From the result of XPS analysis, it was clear that the chemical composition was changed by the Ar-plasma treatment. The cohesive force between the adjacent fibers increases and fiber movement is depressed. Anti-felting effect of Arplasma treated wool fabrics is caused by the depression of fiber movements

even in the water. As the wool fiber surface becomes rough by the etching and functional groups which have strong interaction with water are formed on the surface, the wool fabric show larger hysteresis in bending and shearing. Therefore, wool fabrics become shrinkfree by Ar-plasma treatment. When the plasma-treated fabrics were processed with weak amino-silicone solution, those mechanical parameters of KES and drawing-out intensity fell down to the level of original untreated fabrics. Anti-felting effect also diminished at the same time.

Key Words: [Wool fabric](#), [Low-temperature Plasma](#), [Felt-shrinkage](#), [Mechanical properties](#), [Drawing-out strength](#)

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