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FUNCTIONALIZATION OF TEXTILE MATERIALS BY PLASMA TECHNOLOGY FOR METALLIC MICROPARTICLES DEPOSITION

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Abstract: *In this paper we propose a method based on plasma technology, which does not cause damage of the fabric. In our work are described aspects regarding textile functionatization by plasma activation treatment for metallic deposition in order to obtain flexible electronics. By plasma activation the textile surface can be modified and can be obtained the optimal surface energy for additional treatments such as metallization by microparticles deposition for developing the electroconductive surfaces with great potential for use in sensors/actuators devices, EM shielding and with antistatic properties. Our work presents comparative aspects of the hydrophobic/hydrophilic surface obtained by plasma coating and used for metallization.*
The most used treatment for optimal surface energy preparate the textile surface for metallic deposition (print, lamination or padding) are based on the surface treatment such as plasma, inluding corona treatment and chemical treatment using classical techniques (padding).
The massive development of wireless communication systems and the miniaturization trend in electronics has generated a need for flexible wearable electronics based on conductive lightweight surfaces. The classical technology for metal deposition for electronics involves high temperature fabrication processes. Generally, the metal depossition in microfabrication processes, in semiconductors industry, is performed by chemical vapor deposition (CVD), electrodeposition and epitaxy.

Key words: *plasma technology, magnetron, electroconductive, metallic, textile.*

1. INTRODUCTION

On the microfabriaction industry is used the CVD techniques, electrodeposition and epitaxy. Unfortunately, the classical technology for metal deposition for electronics involves Si substrate, which is not flexible, and requires a high temperature fabrication processes [1].

The most used CVD techniques are LPCVD and PECVD and involve very high processing temperature (1000^0 C) in comparison with PVD (physical vapour deposition) techniques that require below temperatures ($200\div500^0$C) [2]. Therefore, both CVD and PVD techniques, involve temperatures enough high to cause damage to the fabric. The coating techniques based on vacuum deposition such as chemical vapor deposition (CVD) and physical vapor deposition (PVD). By CVD coating technology, a thin film obtained by chemical reaction between precursors. The inconvenient is that this technique requires a high-temperature medium. By PVD technique, the surface can be modified by evaporation and sputtering. Plasma technology for surface activation is requirement for metallic deposition on the textile surface [3] for small electronics (actuators/sensors) [4]. The plasma technology is eco-friendly and dry technology that can be used for obtain functional surfaces with antibacterial, electrical, mechanical, hydrophobicity and water repellence characteristics improved.

Several treatments used for textile surface energy modeling include plasma treatments for obtain the hydrophilic or hydrophobic textiles for metallic deposition (print, lamination or padding) and chemical treatment using classical techniques (padding) [5].

2. EXPERIMENTAL PART AND DISCUSSIONS

The textile sample, cotton 100% with mass 401 g/m^2, was treated in plasma was used Teflon coating. After plasma treatment we observed the hydrophobic surface are partial stable in time (figure 1 and 2), but sufficiently stable in order to deposit an electro-conductive layer. In our previous experiments [6] by hydrophobization in plasma we obtained a material with good surface for metallization and by hidrophylization we try obtain the surface activation before classical hydrophobization treatment in order to reduce the chemicals consumption.

a. Afer 24 h *b. After 1 month*

Fig. 1. *Contact angle view for textile treated in plasma*

The hydrophobicity effect of the coated textile surfaces was analyzed by determining the water contact angle using the device VCA OPTIMA (figure 1) and spray rating tester (water resistance tester) James Heal (figure 2). The physico-chemical investigations for water resistance spray test were obtained using SR EN ISO 4920/2013 standard method and contact angle using ASTM D7490-08 standard method [6-7].

Fig. 2. *Spray test rating – James Heal*

After analysing the textile hydrophobization process in plasma we can conclude that this process affects drastically only the energy consumption (figure 3) and indirectly ozone layer dimension and clima changes, fossil fuels consumption and health by inspiration of the nocive gas waste.

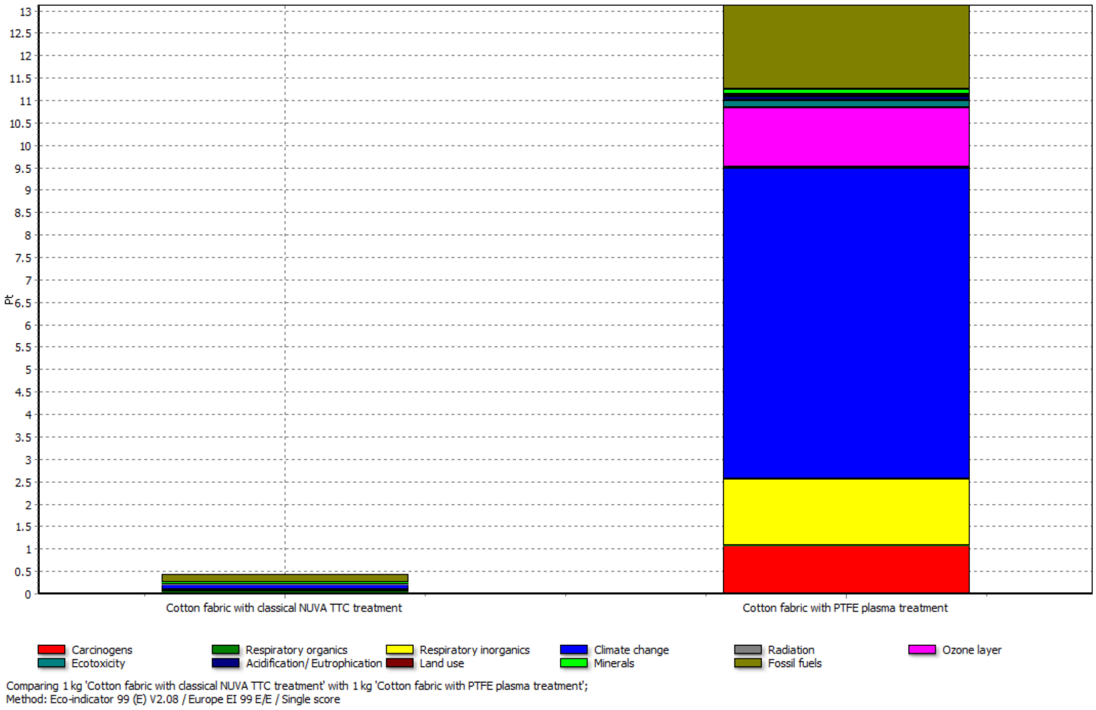

Fig.3. *Plasma hydrophobization impact*

Even if the plasma processes involves many harmful chemicals [8-11] and energy consumption, is still used in researches [12-14] and in industrial applications. For obtaining the textile with electrical or insulator properties it is very important to obtain dielectric surface, conductive surface and this involves, after plasma hydrophobization treatments, some deposition of the metallic powders [4].

4. CONCLUSIONS

There are some advantages of the using the water repellent treatment by plasma is that we can reduce to zero the environmental water waste and it is a clean procedure.

Unfortunately the plasma procedures are already reported as harmful to human health because of the chemicals used. But still, we can use this treatment for small piece treatment in order to obtain the conductive textiles [12].

The plasma treatment advantages are:

-Do not generate water waste;

-It generates reducing the carbon footprint;

-Reducing time for textile finishing;

The plasma treatment disadvantages are:
- High energy consumption;
- Potential hazard substantanced eliminated in the environments;
- Sofisticated equipment manufacturing;
- Increased cost with personal high qualified and equipment mentenance.

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