Development of the Textile Conductive Nonwoven by Copper metal coating approach for E-Textile Applications

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Abstract: This poster presents manufacture and characterizes the polyester nonwoven fabric through the copper metal coating approach. Thus, I selected polyester nonwoven fabric sample to see the effect of different properties on the conductivity of the samples.
I investigated the physical properties of polyester nonwoven sample such as thickness, the durability of the fabric and the impact of abrasion on the normal and conductive samples. I also explored the surface morphology of polyester nonwoven sample before and after the coating process via scanning electron microscope (SEM) and it showed a remarkably uniform deposition of copper metal particles on the fabric surface and performed the energy dispersive spectroscopy (SEM-EDX) analysis to determine the elemental composition on the surface of the fabric after the metal coating process.
The results revealed that polyester nonwoven sample showed excellent conductivity value (0.71429S/cm) and could be ideal for Electronic textile applications such as sensors.

Introduction:

Electronic textile is an emerging field, and there are a lot of researches has been conducted and is going on. Electronic textile applications are using in many areas like health monitoring, sports performance training, security, military, and entertainment. Electronic textile systems consist of several different modules that fulfill different jobs within a system.
Recently, the electroless plating process has emerged as a predominant method of the textile surface metal coating due to excellent achievement regarding conductivity, consistent metal coating, and durability and it can be used to make electrically conductive to all types of materials including plastics, glasses and it is cost-effective.

The electroless plating process is more promising due to the simple technique and low cost as compared to other available options

Objective:

The main objective of my research work is to make the polyester nonwoven conductive and utilize it in different electronic textile applications.

Process Technology:

There are different methods to make the fabric conductive, e.g. electroplating, sputtering and the electroless plating process. For this study, I have selected the electroless plating process. The electroless plating method was chosen to fulfill this aim since the process allows the coating of non-conductive textile materials, and it is relatively cheaper compared to other available options for making the conductive fabric. Electroless plating is used to deposit a coating of a metal on a substrate without using an external power source, such as electricity. Unlike electroplating, usage of direct electric current is not required.
Electroless plating process comprises three steps named as sensitization, activization and plating process. The complete steps of the electroless process are illustrated in the fig. 1.
The surface morphology of the cu-plated polyester nonwoven was observed by SEM and images are reported in fig. 2 and fig. 3.
No peeled-off path on the surface was observed. the surface of the coated nonwoven sample was found to be covered by bright copper coating. The results indicated that all the bright copper coating is due to copper metallic materials used in the electroless plating process.

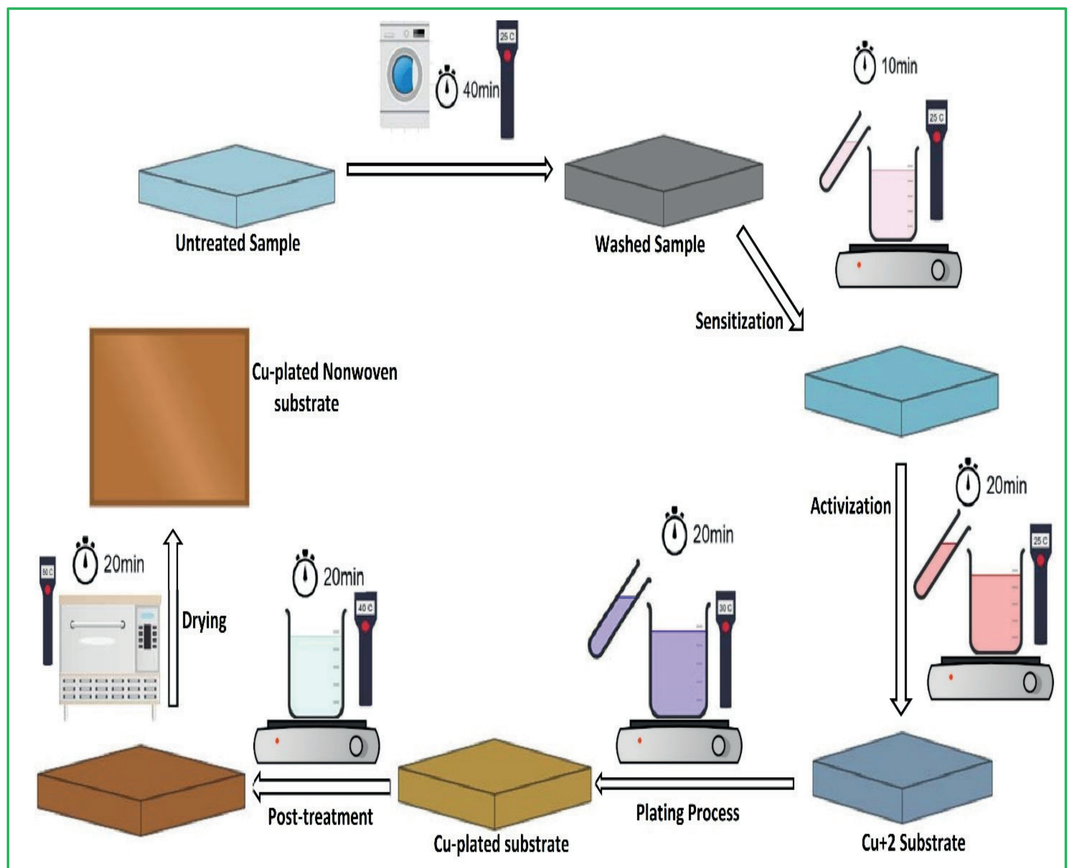

Figure 1. Schematic illustration of the process of laser-treated conductive Nonwoven via electroless deposition

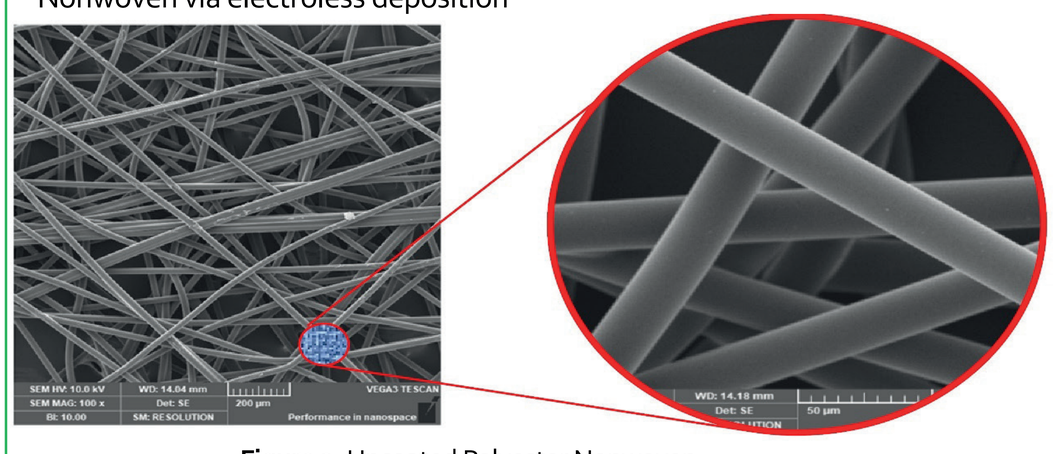

Figure 2. Uncoated Polyester Nonwoven

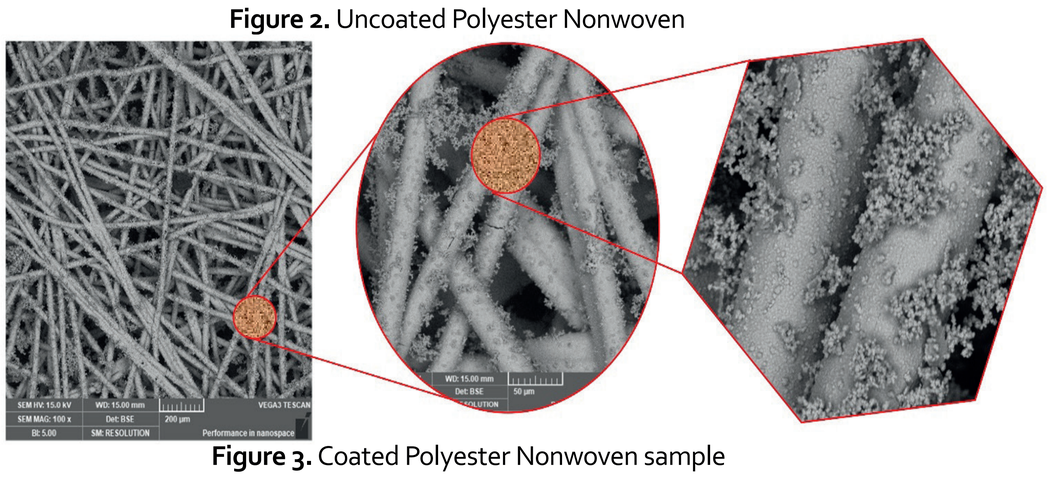

Figure 3. Coated Polyester Nonwoven sample

Conclusion:

The present study was focused on the development of copper-plated polyester nonwoven. The copper metal was successfully deposited on the surface of the polyester nonwoven through the copper metal deposition method. Polyester nonwoven showed the excellent conductivity value (0.71429S/cm).
Electrical conductivity is very important in electronic textile applications. So, we have proceeded with polyester nonwoven as a suitable candidate for different E-Textile Applications like sensors.

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References:

1. Ryu S, et al. Extremely Elastic Wearable Carbon Nanotube Fiber Strain Sensor for Monitoring of Human Motion. *ACS nano* 2015; 9(6): 5929-5936.
2. Zhang, et al. Large-scale assembly of highly sensitive si-based flexible strain sensors for human motion monitoring. *Nanoscale* 2016; 8, 2123–2128.
3. Mishra R, Militky J, Baheti V, Huang J, Kale B, Venkataraman M, Wang Y. The production, characterization and applications of nanoparticles in the textile industry. *Textile Progress* 2014; 46, 133–226. doi: 10.1080/00405167.2014.964474
4. Yip J, Jiang S, Wong C. Characterization of metallic textiles deposited by magnetron sputtering and traditional metallic treatments, *Surf. Coat. Technol. 204* 2009; 380–385.
5. Guo Z Z, Yu Y, Zie Z, Liu X, Zhou X, Gao Y, Liu Z, Zhou F, Yang Y, Matrix assisted catalytic printing for the fabrication of multiscale, flexible, foldable, and stretchable metal conductors, Adv. Mater. 24 (2013) 3343–3350.
6. Huo R H, Jiang S X, Yuen C W M. Metallized textile design through electroless plating and tie-dyeing technique. *J. Text. Inst. 104* 2013; 1049–1055.
7. Hassan Z, Atalay O, Kalaoglu F. Development and characterization of conductive textile (cotton) for wearable electronics and soft robotics. *Textile Research Journal* (Paper accepted)
8. Zhang B. Amorphous and Nano Alloys Electroless Depositions. *Technology, Composition, Structure and Theory* 2016.
9. Uzunlar E, Wilson Z, Kohl P A. Electroless copper deposition using Sn/Ag catalyst on epoxy laminates. *J. Electrochem. Soc. 160* 2013; D3237–D3246.
10. Aldakov D, Bonnassieux Y, Geffroy B, Palacin S. Selective electroless copper deposition on self-assembled dithiol monolayers, *ACS Appl. Mater. Interfaces 1* 2009; 584–589.
11. Abyaneh M Y, Sterritt A, Mason T J. Effects of Ultrasonic Irradiation on the Kinetics of Formation, Structure, and Hardness of Electroless Nickel Deposits, *Journal of Electrochem. Soc.* 2007; 154: D467.