Parylene-C encapsulated Cu coated nonwovens for thermotheapy application

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Abstract: Due to the many advantageous characteristics of metallized textiles, such as their softness, good conductivity, and ease of processing, their application in thermotherapy has gradually expanded[1]. However, challenges remain, including the susceptibility of metal coatings to oxidation, allergic reactions in sensitive skin, and corrosion by perspiration, as well as issues related to the breathability of the material after treatment of the metal coating[2].

This study employs Parylene-C as an encapsulating material, utilizing a specific equipment-based vapor deposition method to completely encapsulate fabrics with metal particle coatings in a Parylene-C film without covering all fabric pores and ensuring a certain level of breathability. After the encapsulation process, the thickness of the sample was increased, and the porosity was decreased. Scanning Electron Microscope (SEM) images reveal that Parylene-C fully encompasses the surface of the fibers, increasing their diameter and rendering the surface metal particles invisible. Parylene-C is a biocompatible material, indicating that in practical applications, metal particles will no longer come into direct contact with the human body, thereby avoiding allergic reactions to metals. Even though the overall porosity of the fabric decreases after encapsulation with a Parylene-C coating, it retains an elegant degree of breathability, distinguishing it from traditional protective coatings where the protective film does not completely seal the fabric pores. Prior to encapsulation with Parylene-C, conductive strips with protective tape were attached to the ends of the material. After removing the protective tape post-encapsulation, applying a direct current to the conductive strips enables fabric heating through the Joule effect. This method allows the material's surface temperature to reach approximately 45°C with a 2V voltage application at the ends, fully meeting the temperature requirements for thermotherapy. The wear resistance of the material significantly improves after encapsulation with Parylene-C; for materials encapsulated with 15g of Parylene-C, the surface remains undamaged after 6000 friction cycles.

Overall, the encapsulation with Parylene-C maintains the high Joule heat effect of copper-plated non-woven materials, enhances wear resistance, and broadens its application in the field of thermotherapy.

KEYWORDS: ***PARYLENE, COPPER COATED NONWOVENS, THERMALTHERAPY.***

Table 1 Basic physical characterization of raw CuPET and Parylene-C encapsulated samples Py/CuPET

Sample	*GSM(g/m²)*	*Thickness(mm)*	*Porosity (%)*
CuPET	23.12	0.074±0.005	58.2
Py2CuPET	27.22	0.078±0.007	47.6
Py4CuPET	30.77	0.084±0.008	42.1
Py6CuPET	35.68	0.085±0.007	38.2
Py8CuPET	42.07	0.09±0.006	31.2

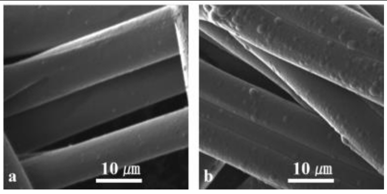


Figure 1 (a) CuPET fiber surface (b)2g Parylene-C encapsulated CuPET (Py2CuPET) fiber surface

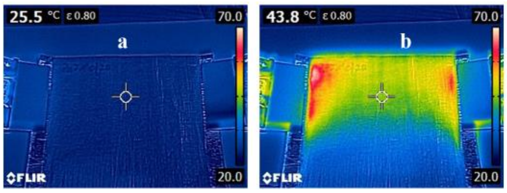
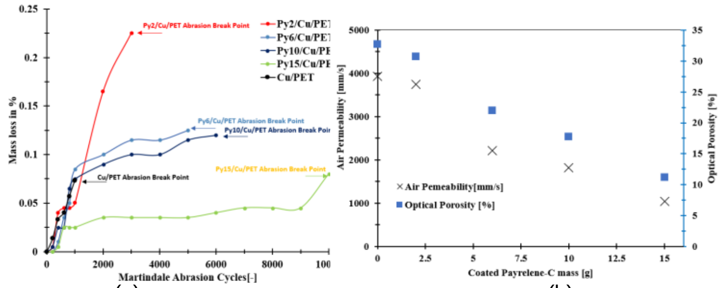


Figure 2 (a) Ohmic heating test on 0s. (b) Ohmic heating test on 3min



(a) (b)

Figure 3 (a) Abrasion test result . (b) Air permeability change with decreased porosity

ACKNOWLEDGEMENT: *This work was supported by the by the Czech Science Foundation (GACR)-project Advanced structures for thermal insulation in extreme conditions (Reg. No. 21-32510M)*

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