

Pretreatment of textiles through atmospheric plasma

Inês Pinheiro ^{1(*)}, Alice Ribeiro ¹, Verónica Bouça ¹, Lorena Coelho ¹, Catarina Nobre ¹, Jorge Padrão ², Andrea Zille ²

¹ Centre of Nanotechnology and Smart Materials (CeNTI), Rua Fernando Mesquita, 2785, 4760-034 Vila Nova de Famalicão, Portugal

² 2C2T, Centre for Textile Science and Technology, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal

(*) Email: ipinheiro@centi.pt

AREA AND APPLICABLE TOPICS

- Skills for Industry
- Twin Transition: Green and Digital
- Resilience
- New Business Models
- Materials (R)evolution

ABSTRACT

There are several technologies available for the treatment of textile substrates. In a context where more environmentally and sustainable attitudes need to be adopted, industries must find technologically advanced solutions towards it, such as waterless technologies. An example is the atmospheric plasma, which allows the continuous and uniform pre-treatment of textile substrates, to make the next step – functionalization – more efficient. This alternative technology allows cleaning textile surfaces, remove organic contaminants and low molecular weight materials, as well as increase surface energy with the improvement of adhesion and creation of active chemical groups for prior bonding. This technology presents many advantages, like the speed of treatment, the possibility of cleaning and activation the surface in a single step, reduction of energy consumption, maintenance of the intrinsic properties of textile substrates, no need of water or chemical reagents and, consequently, no liquid effluents are generated; being, in general, a cleaner process.

PLASMAMED project exemplifies the application of this specific technology. The goal is to produce a new generation of coatings containing bionanocomposites with controllable antibacterial activity on medical textiles, using plasma at atmospheric pressure for the pretreatment of textile substrates, aiming to obtain antimicrobial dressing for pressure injury. Thus, different substrates (cotton, polyester, polyamide) have been pretreated by atmospheric plasma technology, where different conditions of speed and discharge power have been tested, as well as various gases (such as helium, oxygen, nitrogen, or synthetic air), using argon as carrier gas. In general, water contact angle measurements and wicking tests confirmed that plasma modification increased the wettability of textiles substrates, with lower values of contact angle and greater wetting distance achieved, when compared with standard values of the substrates without pretreatment. Additionally, this treatment proved to be more effective than common washing, in removing surface impurities, allowing better results by both methods. After optimizing plasma treatment conditions, polyester-based textiles were functionalized with nanoparticles, enzymes as antimicrobial agents, immobilized using mordenite zeolites and polysaccharide-based matrixes to mitigate cytotoxicity. Antimicrobial tests showed high antimicrobial activity.

Therefore, the results show the possibilities of using plasma in the modification of polymeric surfaces, through the increase of surface energy, as for specific functionalization, compared to the absence of pretreatment.

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