Development of a prototype based on TiO_2 coated textile substrates with photocatalytic and self-cleaning properties

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Abstract

The adhesion to the European Commission and the creation of an internal market with free circulation of goods, people, services and capitals have put a challenge in the adaptability of the transforming industry. The industrial context have changed with the intensity of the globalization process which was based on a logic of vertical disintegration, either by increasing the interdependence between manufacturing and services in the reorganization of companies' productive processes, either by their geographical relocation and formation of international value chains. The textile and clothing Industry, typically defined as "traditional" is a significant part of the manufacturing industry in Europe and also ensures a considerable amount of jobs. By another hand, the number of small and medium enterprises (SMEs) that cluster in specific regions reinforces its importance in social, economic and cultural terms. Although there have been considerable changes in the recent years, there is widespread recognition that the production based on traditional textile products will not be enough to empower this business area. In this sense, the textile and clothing and become competitive.

Nanocoatings applied in textile finishing are a very attractive way to add value to day-to-day products offering an interesting set of important and differentiated properties. The photocatalytic activity of titanium dioxide (TiO2) based nanomaterials for textile applications has been identified as a strategic vector with great industrial impact. The development of photocatalytic, self-cleaning and antimicrobial surface finishes in common textiles has the potential to be used as a prophylactic measure to reduce the infection rates in hospitals as well as reduce the environmental impact of washing processes.

The main goal of this research work was the production of TiO2-based finished textile substrates without changing its surface characteristics such as aesthetic and sensorial (e.g. touch feeling) properties. The applied textile finishing technique in this research work needs less to none of the solvents or surfactants commonly used in the industry leading to a cleaner production process reducing significantly the environment pollution. Pulsed DC Magnetron Sputtering technique was used to deposit TiO2 thin films onto glass and Poly(lactic acid) (PLA) and cotton based substrates (10x10 cm). The samples were characterized via Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD), Atomic Force Microscopy (AFM), Contact Angle measurements and UV – visible Spectroscopy techniques. The photocatalytic activity of the samples was studied by measuring the Methylene Blue (MB) degradation over time as a result of the catalyst exposure to ultraviolet (UV) radiation and its correlation with the initial concentration. The produced ultrathin films (with a thickness of 130 nm) presented a photocatalytic efficiency of about 30%.

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