Plasma-assisted deposition of microcapsule containing *Aloe vera* extract for cosmeto-textiles

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Introduction

There is a growing interest in the application of cosmeto-textiles to incorporate durable fragrances and skin softeners to textile.[1] Microencapsulation technology is a growing area in textile industry.[2, 3] The main disadvantage of using film-forming binders in the application of MCs onto textiles is hindrance of the active substances to be release. To overcome this issue MCs can be covalently linked onto textile substrate by using chemical or physical methods.[4] In recent years plasma technology has assumed a great importance.[5] It is a dry, environmentally- and worker-friendly method to achieve surface alteration without modifies the bulk properties of different materials.[6] It improves the fibre-matrix adhesion by introducing chemically active groups and changing the surface roughness.[7] The dielectric double barrier discharge (DBD) is one of the most effective non-thermal atmospheric plasma to improve the adsorption and adhesion of MCs in textiles [8-10]. The main objective of this study is to investigate the adhesion of MCs containing *Aloe vera* extract applied by padding and printing methods in a cotton/polyester (50/50) fabric (Co/PES) pre-treated with a DBD plasma discharge in air. Fabrics were analysed by contact angle, SEM and FTIR analysis. The printing and padding methods was compared in term of MCs coating efficiency, plasma dose and washing fastness.

Materials and methods

Commercial Co/PES (50/50) fabric with a warp density of 16 threads cm^{-1}, a weft density of 14 threads cm^{-1}, a 20 tex yarn count in both yarns and a surface density of 114.70 g m^{-2} was used in this study. Commercial polyurethane-based microcapsules of liposoluble *Aloe vera* essence in aqueous dispersion were used (Bayscent®, Tanatex Chemicals, Netherland). DBD was applied at different dosages in a semi-industrial machine (Softal Electronics GmbH/University of Minho) working at room temperature and atmospheric pressure in air (1 kW, 5 m min^{-1}). Contact angles were mesuared with Dataphysics equipment using OCA20 software (Filderstadt, Germany). Fabric samples of 10×5 cm were padded in a foulard and printed with 80 g l^{-1} MCs and dried at 140 ºC for 3 minutes. FTIR spectra were recorded in a Nicolet Avatar 360 ATR-FTIR (Madison, USA). SEM analysis were carried in a FEG-SEM, NOVA 2000 Nano, FEI Company. Washing fastness was evaluated according to the standard ISO 105 C06, A1S method at 40 ˚C.

Results and discussion

ATR-FTIR of Co/PES fabric after plasma treatment shows a significant increase in the intensity and broadening of the C=O stretching band as well as of the vibration peaks of the C-O-C bond of the glycosidic bridges. The introduction of the MCs onto the fabric surface shows a remarkable increase in intensity of the peaks related with polyurethanes. MCs display a spherical shape with size between 2 and 8 µm with an average wall thickness of 0.5µm (Figure 1). MCs applied by printing in fabric treated with a plasma dosage of 1.6 kW m2 min-1 (contact angle ~16º) showed the best results with an

increased adhesion of 200% and significant penetration of MCs into the fibres network. Plasma printed fabric retained 230% more MCs than untreated fabric after 10 washing cycles. However, the coating efficiency between unwashed and washed samples was only improved by 5% (Table 1). Considering the fact that no binder or crosslinker agents were used, the DBD plasma-assisted deposition of MCs revealed to be a promising environmental safe and low cost coating technology.

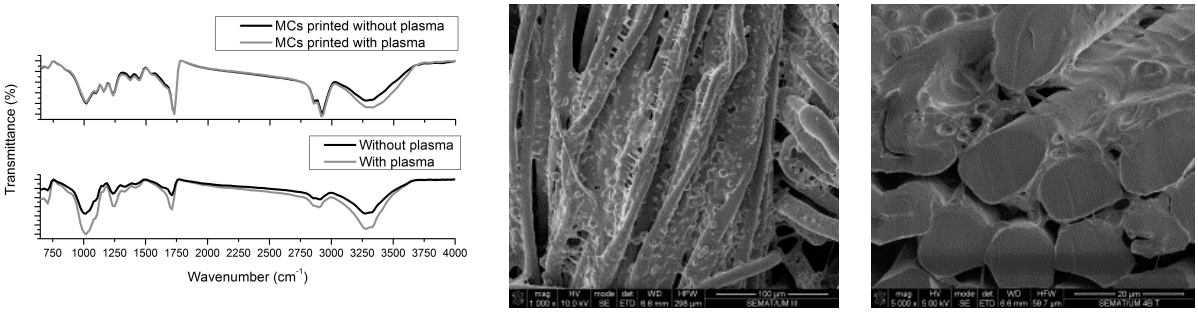

Figure 1. ATR-FTIR of uncoated and coated Co/PES fabric without (black lines) and with plasma treatment (grey lines). Surface and transversal cut SEM of plasma treated fabric coated with MCs.

Table 1. Microcapsules distribution (area 10 μm^2) in function of plasma dosage and washing fastness.

	Plasma dosage (kW m^2 min^{-1})					
	0	**0**	**0.4**	**0.8**	**1.6**	**2.4**
	Padding	**Printing**				
Unwashed	246	466	654	772	939	950
5 washing cycles	120	225	339	392	479	470
10 washing cycles	67	160	259	320	370	367

Conclusion

The application of cosmeto-textile microcapsules can be made through the printing process in plasma pre-treated fabrics providing greater adhesion, better resistance and reduced costs.

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