Journal of Fiber Bioengineering and Informatics 9:4 (2016) 201–212
doi:10.3993/jfbim00254

Application of Electrospray Coating Technique to impart Multifunctionality to Textile Substrates

Amit Jadhav*, Lijing Wang, Rajiv Padhye

School of Fashion and Textiles, RMIT University, 25 Dawson St, Melbourne, VIC-3056, Australia

Abstract

Electrospray coating is a method of generating fine droplets of polymer through high electrostatic charging. It involves electrohydrodynamic process for forming fine polymer droplets. These droplets are highly charged that promotes self-dispersion which results in uniform coating on substrate. Electrospray coating can be successfully utilised as a coating technique to coat textile substrates. Textiles substrate coated with electrosprayed polymer droplets have a large specific surface area and it facilitates submicron range coating compared to conventional coating methods like roller coating or knife coating. This research study investigates the electrospray coating of thermoplastic polyurethane polymer on textile substrate. The results showed that electrospraying facilitated the submicron size droplets deposition on textile substrates which imparted the waterproof property to the substrate without altering the moisture management and surface properties of textile substrate.

Keywords: Electrospray Coating; Thermoplastic Polyurethane; Surface Roughness; Contact Angle

1 Introduction

Coating of textiles was developed by ancient people of Central and South America. Latex was used as a coating material to make the fabric waterproof. The coated fabrics were used for protection against extreme weather [1]. Currently, most of the textile fabrics are coating with polymers. Due to tremendous development in polymer chemistry, many functional polymers are available to use in textile industry. It helped to expand the application of textiles in diverse area. Coated textiles find an important place among technical textiles and are one of the most important technological processes in the modern textile industry.

The intrinsic properties of a coated textile depend on the type of polymer used and its formulation, the nature of the textile substrate, and the coating method employed. Most of the coated textiles are produced by conventional coating methods such as knife or roller coating. There are issues associated with these coating methods, for example, impregnation of the polymer into the yarn/fibre interstices, which alters the original properties of the fabric. Electrospray coating has

*Corresponding author.
Email address: amit.jadhav@rmit.edu.au (Amit Jadhav).

the ability to deposit polymer droplets at submicron level due to electrostatic charging. The submicron level coating facilitates the retention of the fabric's original properties so that the fabric can deliver additional functional properties depending on the polymer characteristics.

The spraying of fine polymer droplets results in very smooth and even coating. Surface coating of polymer with electrospray coating is a promising technology for the near future in the field of coating of materials [2]. Electrospraying has opened new routes to nanotechnology. Electrospraying is used for micro- and nano-thinfilm deposition [3], micro- and nano-particle production [4], and micro- and nano-capsule formation. Thin films and fine powders are (or potentially could be) used in modern material technologies [5], microelectronics and medical technology [6, 7]. This research work discusses the potential applications of electrospray coating for textile substrates. Thermoplastic polyurethane polymer was sprayed onto cotton fabric to impart waterproof-breathable functionality.

2 Experimental

2.1 Textile Materials

Fabrics produced from cotton or wool, natural fibres are mostly used for coating to enhance their properties and hence were chosen for this study. Mercerised and bleached cotton fabric was received from Bruck Textiles, Australia. 100% wool was sourced from Macquarie Textiles, Australia. Both fabrics were used as received without any further chemical treatments. The fabric specifications are given in Table 1.

Table 1: Fabric specifications

Characteristics		Cotton	Wool
Weight (g/m^2)		200	230
Yarn count (Tex*)	Warp	48	36
	Weft	90	41
Ends/cm		34	36
Picks/cm		22	24
Weave		Plain	2/1 twill

*Tex — weight in grams per 1000 m of yarn

2.2 Chemicals

Thermoplastic polyurethane (TPU) of M_w30 000 received in the form of chips from Pacific Urethanes (Australia). Tetrahydrofluran (THF) were received from Sigma Aldrich Chemicals Co. (USA), The THF was used as solvent for dissolving polyurethane because THF has a high evaporation rate. Its boiling point is 66 °C, viscosity 0.55 cP and density 0.888 g/ml. All chemicals were used as received without any purification. Polyurethane solutions of different concentration were prepared by dissolving the polymer granules homogenously in tetrahydrofluran for electrospraying.