UNIVERSITY OF BIRMINGHAM

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Electrospinning of Continuous and Aligned Nanofibers

An electrospinning method for the continuous production of highly aligned nanofibers and quasi-isotropic preforms

Please note, header image is purely illustrative. Source: pxhere, CC0

IP Status

Patent application submitted, Provisional patent

Seeking

Licensing, Development partner

About **University of Birmingham**

At the University of Birmingham our research leads to new inventions and fuels innovation and business growth.

Background

Electrospinning of polymers from the melt or solution is a simple but versatile technique to produce nano and micro-fibers. It allows good control over the fiber diameter and surface finish. Electrospinning has been used for manufacturing non-woven mats, solid and hollow fibers and twisted yarns. In the context of strength and stiffness of the electrospun preforms, a key requirement is fiber alignment and compact packing (high fiber volume fraction).

A number of techniques have been demonstrated previously to manufacture highly aligned nanofiber preforms, for example, using parallel electrodes or rotating mandrels to collect the fibers. However, those techniques do not achieve continuous manufacturing of preforms for structural and device applications where the aligned fibers can be extracted as a sheet, prepreg, ribbon or roll.

Moreover, the porosity within the conventionally electrospun preform is difficult to control. The strength of the preform can be enhanced significantly by minimizing the gaps between the individual fibers. With traditional electrospinning, the required strength of the preforms is achieved by manipulating their thickness. Alternatively, the strength of the preform can be improved by depositing the nanofibers in a quasi-isotropic manner (zero, ninety and forty five degree orientations), however, continuous and inexpensive production of such preforms or laminates has not been successfully demonstrated before.

Tech Overview

The electrospinning technology and equipment developed by researchers from the University of Birmingham is capable of: (i) producing continuous and aligned nanofibers on a demountable substrate; (ii) the nanofibers can be deposited continuously at zero and/or any angle between zero and ninety degrees – in other words, quasi-isotropic fiber preforms can be manufactured without a need for layer-by-layer lamination.

Figure 1 - Continuous electrospinning of tightly packed and highly aligned nanofibers on a ribbon substrate.

Benefits

Continuous: The equipment allows non-stop production of highly aligned fibers or fiber mats;

Robust: Generated fibers can be easily removed from the substrate without loss of alignment;

Tuneable: The equipment allows quick and easy adjustment of the deposition angle;

Inexpensive: Technology can be easily incorporated into existing laboratory and mass-scale electrospinning set-ups;

Unique: Technology allows multiple angle aligned deposition for continuous fabrication of quasi-isotropic materials and fiber mats;

Wide range: The angle of fiber alignment in the fiber mats can be any from 0 to 180°.

User-friendly: The equipment does not require any additional specific training to operate.

Applications

- Nanocomposites
- Filtration and separation materials
- Wound dressing
- Tissue scaffolds
- Electrodes
- Sensors and light guides
- Smart fabric
- Cellulose-based packaging materials
- Carbon fiber preforms
- Flexible electronics

Opportunity

- Licensing.
- Co-development

ZSR1096

Appendix 1

Figure 1

Continuous electrospinning of tightly packed and highly aligned nanofibers on a ribbon substrate