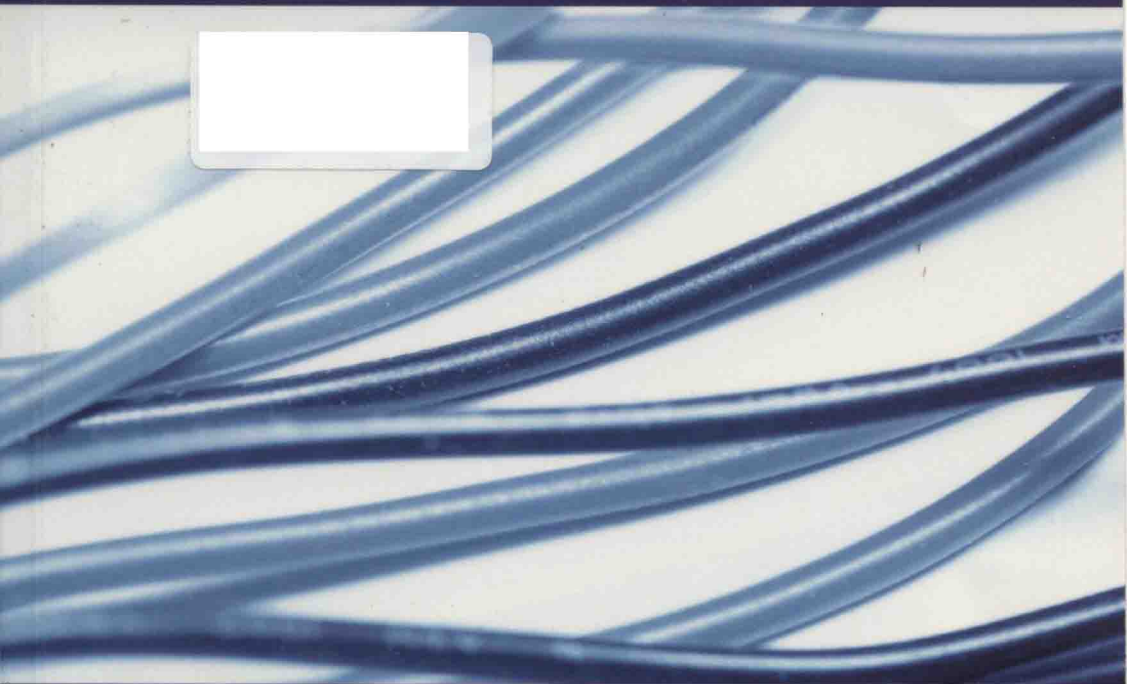




Haitao Niu
Tong Lin
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Electrospinning of Polymers for Functional Nanofibres

Fibre generators, Fibre morphologies and properties

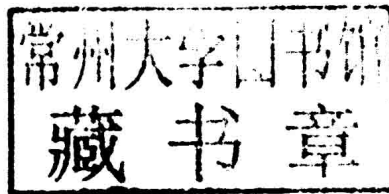


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Haitao Niu
Tong Lin
Xungai Wang

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Dedication

This work is dedicated to my parents, Mr. Ximing Niu and Mrs. Guihua Zhang, and my wife, Hua Zhou, and my son Zichen Niu, for their endless love and support!

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Abstract

Electrospinning is very useful method to produce polymeric nanofibres with controlled fibre fineness and morphology. Electrospun nanofibre membranes can be used in diverse applications due to their porous structure, high surface area and tuneable functionality. In spite of big improvements in this technology, some problems associated with electrospinning still remain unsolved. Needle electrospinning typically has a low production rate, which has been the main obstacle to the commercialisation of electrospun nanofibres. Needleless electrospinning has much higher nanofibre productivity than needle electrospinning. However, how the spinneret shape affects the electric field profile in needleless electrospinning, the electrospinning process, fibre morphology and productivity has not been fully elucidated. Sylgard 184 has been regarded as a highly useful polydimethylsiloxane (PDMS) elastomer, but the successful electrospinning of Sylgard 184 elastomer remains a challenge, because its curing process requires 48 hours at room temperature or 10 hours at 60 °C. Will the core-shell electrospinning technique be able to produce PDMS fibres? Electrospun carbon nanofibres, showing porous structure and large surface area, find good applications in catalysis, filtration, energy storage, and battery. However, there has been no report on the morphology and properties of carbon nanofibres from bicomponent polymer nanofibres. How to use side-by-side nanofibres to produce inter-bonded fibrous network has not yet been demonstrated. Ag containing nanofibres endow the fibres with good catalytic and antivirus properties. However, the controlled growth of Ag crystals on electrospun nanofibres hasn't been reported. It remains unclear if the Ag nanoparticles within PAN nanofibres can be induced to undergo an *in-situ* reduction so that Ag can be formed just on the surface of PAN fibres.

The objectives of this project are:

- a) to elucidate the influence of spinneret shape on needleless electrospinning process, fibre morphology and productivity;
- b) to produce Sylgard 184 PDMS fibres from a co-electrospinning process and examine the influences of post-electrospinning treatment on the resultant PDMS fibre morphology and elasticity;
- c) to produce inter-connected carbon nanofibres using side-by-side co-electrospinning followed by carbonisation treatment and examine their properties and electrochemical performances; and
- d) to produce PAN core-Ag sheath electrospun fibres through a post-electrospinning treatment, and examine the influence of treatment conditions on the morphology of Ag sheath layer.

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