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Title of Project:

(English) Preparation of electrospun tri-fluid Janus-core shell nanofibers and their potential wound dressings applications

(Chinese) 電紡並列/芯鞘多室複合納米結構的可控製備及構建高性能傷口敷料應用研究

Abstract of Research Comprehensible to a Non-specialist

Skin wounds have significant impact on health especially when it is complicated by infection such as MRSA causing secondary infections. The wound healing process involves a series of biochemical events, cell growth and skin regeneration. The effectiveness of wound treatments and after care are paramount for the re-establishment of the structure and functions of the damaged skin, avoiding wound infection and allowing rehydration of the new skin.

There are ways to tackle wound healing through the design of wound dressings to prevent infections and to enhance skin regeneration. However, design of an ideal wound dressing can be challenging because the dressing itself does not only act as a drug delivery platform, but it also needs to deal with a continuous changing biological environment, for example, by-products produced by the biochemical reactions and debris from the infectious agents.

In this proposal, we attempt a multi-layer approach to investigate the feasibility of building multi-purpose combination wound dressings that can simultaneously combat infections, manage the wound healing process, and enhance skin regeneration. Our criteria for selecting a drug delivery system in wound dressing are ways to maintain the drug's bioactivity, bioavailability and controlled release. The drugs used in this project will be anti-microbial agents and growth factor for skin regeneration. These drugs have very different chemical characteristics and properties. It is therefore important to design a drug delivery system that can enhance their synergistic therapeutic effects. In addition, we are incorporating a layer of absorbent to manage the wound environment.

Here, we aim to develop a novel tri-fluid electrospinning process, by which a new type of nanostructures (i.e. Janus with a core-sheath side, J//CH) will be prepared using a novel designed tri-nozzle electrospinning tip. With natural and synthetic polymers as the filament-forming matrices, different functional ingredients (including ZnO nanoparticles, herbal medicines, essential oil and hyaluronic acid/epidermal growth factor) will be loaded into different chambers of the complex nanostructures through different manners. A series of tests will be conducted to evaluate the morphologies and structures of the nanofibers, their physical properties, the state and compatibility of the components, and their functional performances at different stages (in vitro, cell, animal, histological analysis, antibacterial and antioxidant analyses, and immunological analysis). The processing-structure-property relationship of electrospun chamber J//CH nanofibers will be ascertained for its feasibility as future wound dressings alternative.