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Review

Electrospinning tissue engineering and wound dressing scaffolds from polymer-titanium dioxide nanocomposites

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HIGHLIGHTS

- Electrospinning is a scaffold fabrication method.
- Integrating other materials such as metals nanoparticles with polymers is emerging as a route to new composites materials.
- Electrospun polymer-nanoparticles composites are a new frontier in biomedicine.
- We summarise advances in electrospun tissue engineering and wound dressing platforms.
- Polymer-titanium dioxide nanocomposites is discussed here.

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ABSTRACT

Electrospinning is widely used to fabricate nanoscale fibers from natural and synthetic polymers. Electrospun fibers have potential application in tissue engineering as well as in the design of catalysts, batteries, electronic sensors, packages, filtration membranes, medical implants, wound dressings, and medical fabrics, and drug delivery systems. Fibers offer a porous structure with a high surface area to volume ratio, which is a highly desired property in various applications. Integrating other materials such as metals nanoparticles or ceramics in electrospun fibers is emerging as a route to new nanoscale composites materials with enhanced functional properties. Incorporating nanoparticles on or within the nanofibrous scaffold impart functional properties with implication for catalysis, optoelectronics, and biomedicine. Indeed, these electrospun polymer-nanoparticles composites are a new frontier in biomedicine, where their relevance to tissue engineering, wound dressing, drug delivery is emerging. Here, we summarise advances in electrospun tissue engineering and wound dressing platforms developed from polymer-titanium dioxide nanocomposites.

1. Introduction

Damaged tissues or organs could cause fatal health problems. When natural repair is impractical, medical practitioners resort to tissue or organ transplantation to restore the structures and functions of damaged biological systems [1–4]. Demand for transplants currently exceeds supply, creating an unmet clinical need. The United States Department of Health and Human Services reported that 20 people die daily waiting for transplants that are unavailable due to organ or tissue shortage [5–9]. Tissue engineering seeks to address this critical need by developing substitute tissues and organs [10]. Advances, so far, are promising but remain challenged by unsustainable sources of immunologically compatible cells and tissues and lack of structurally and functionally suitable biomaterials. From the materials science and engineering perspectives, new biomaterials construct such as electrospun polymer-nanoparticle composites represent an emerging frontier in the tissue engineering field [11–13].

A significant cause of damaged tissues is traumatic injury- and surgery-caused wounds [4]. Clinical care of wounds seeks to restore the functional and structural integrity of affected tissues and to prevent

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