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A Microneedle based Vaccine Delivery Platform Delivers Targeted Vaccines to the Skin to Activate Antigen Presenting Cells

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DESCRIPTION

Microneedles containing cavities for drug reservoirs and small protrusions for transdermal penetration. Since then, microneedles have been extensively developed for TDD with advances in microfabrication manufacturing and pharmaceutical technology. Solid microneedles were commonly used to pretreat the skin prior to drug delivery. Common materials used to fabricate solid microneedles mainly include silicon, methyl vinyl ether and maleic anhydride, polymethyl methacrylate, polylactic acid, as well as stainless steel, titanium, nickel and other metal materials increase. Solid microneedles can be used for TDD with or without drug coating. Solid microneedles without drug coating can create temporary skin micro-channels and improve drug penetration efficiency for subsequent topical administration. Drug-coated solid microneedles serve as both skin-penetrating modules and drug reservoirs. Although this system can be used to facilitate rapid drug delivery, limitations such as low drug loading capacity, limited bio-compatibility, and imprecise dose delivery must be carefully considered.

For hollow microneedles, unlike solid microneedles, more content can be loaded into the lumen or bore of this type of microneedle than other microneedles. Compared to solid microneedles, hollow microneedles are more complicated to manufacture. Manufacturing processes include laser micromachining, integrated photolithography techniques, and micromachining. When the microneedles are inserted into the skin, the biodegradable material dissolves and releases the active ingredients. Maltose, carboxymethylcellulose, hyaluronic acid, and other degradable materials are commonly used to fabricate dissolvable microneedles. Unlike other types of microneedles, dissolving microneedles are easy to fabricate, and fabrication techniques mainly include photopolymerization, drawing photolithography, and microstructures.

Coated microneedles refer to solid microneedles coated with therapeutic content. Dipping and spraying are the two most common coating methods. In the dipping step, the microneedles are dipped into the target coating solution and loaded with drug. The spray method uses an atomizer or gas jet to coat the surface of the microneedles with the active ingredient. However, the latter can contaminate the substrate through imprecise spraying during the manufacturing process.

Atopic dermatitis is a common chronic inflammatory skin disease caused by skin barrier dysfunction and immune system dysregulation. Corticosteroids are currently the most widely used drugs for the treatment of AD. However, long-term use of corticosteroids can cause skin atrophy, localized burning, or itching. A convenient and inexpensive delivery system is critical for optimal vaccine efficacy. Moreover, compared to needle-based intramuscular injection, the immune memory response induced by microneedle-based administration is enhanced by the continuous release of vaccine loaded into the microneedle lumen. Soluble microneedles made using carboxymethylcellulose and trehalose were used to load an adenoviral vaccine together with the Toll-like receptor agonist polyinosinic acid. Once inserted into the skin, the microneedles collapse and release the loaded adenovirus, causing overexpression of the OVA transgene. In addition, minoxidil-filled microneedles can stimulate hair follicle stem cells and activate skin care growth factors, which can promote hair growth in alopecia, numerous clinical studies have been conducted using microneedle-based products.

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CONFLICT OF INTEREST

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