Use of Combined Polymers in Microneedles Manufacture: Effect of Polymer Type and Permeation Enhancers on Thermal and Mechanical Properties

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Abstract

A promising transdermal drug delivery technology is the microneedle system. Combining Poly vinyl alcohol and Poly vinyl pyrrolidone polymers reduced the total glass transition temperature (T_g) while preserving microneedle penetration and durability. Two penetration enhancers namely PEG400 and urea were used in three different concentrations (1%, 5%, and 10% w/w) to investigate the thermal and mechanical properties of microneedles. The utilization of PEG400 and urea reduces the glass transition temperature and coefficient of friction (COF), which indicates promising outcomes for microneedles application regarding less pain, higher drug permeation and dissolution rates with increased moisturization for skin. The increase in permeation enhancers concentration (5% w/w) led to increased resistance of fracture with the ability to penetrate 2 layers of Parafilm® and rat skin. The thermal and mechanical properties of microneedles were related to the anticipated function of microneedles which is maintaining the shape of the microneedle's tips during storage and application.

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