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Multilayered pyramidal dissolving microneedle patches with flexible pedestals for improving effective drug delivery

Shinying Lau^{a,1)}, Jie Fei^{a,1)}, Haoran Liu^{a,b}, Weixing Chen^a, Ran Liu^{a,2)}

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- a. Department of Biomedical Engineering,
School of Medicine, Tsinghua University,
Beijing, 100084, China
 - b. Graduate School at Shenzhen, Tsinghua
University, Shenzhen, 518055, China
- 1) Shinying Lau and Jie Fei contributed equally to
this work.
 - 2) Corresponding author: liuran@tsinghua.edu.cn

Abstract

Dissolving microneedles have been employed as a safe and convenient transdermal delivery system for drugs and vaccines. To improve effective drug delivery, a multilayered pyramidal dissolving microneedle patch, composed of silk fibroin tips with the ability of robust mechanical strength, rapid dissolution and drug release supported on a flexible polyvinyl alcohol (PVA) pedestal is reported. To show the utility of this approach the ability of the fabricated microneedles to deliver insulin is demonstrated. The dissolving microneedles have sufficient mechanical strength to be inserted into abdomen skin of mice to a depth of approximately 150 μm , and release their encapsulated insulin into the skin to cause a hypoglycemic effect. The fabrication of microneedles avoids high temperature which benefits storage stability at room temperature for 20 d. This result indicates more than 99.4 % of insulin remained in the microneedles. In comparison to traditional needle-based administration, the proposed multilayered pyramidal dissolving microneedle patches enable self-administration, miniaturization, pain-free administration, drug delivery and drug stability, all being important features in needle free drug delivery.

Keywords

microneedles, pyramidal dissolving, multilayer, flexible, insulin, transdermal delivery

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