Modelling Swellable Microneedles For Transdermal Drug Delivery

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Abstract

Swellable microneedles (SMN) have gained a lot of attention to the transport of drugs in the skin. Microneedle swells by absorbing interstitial fluid, causing the loaded drug to transport into the skin without polymer dissolution which reduces the chance of infection and skin irritation. Drug delivery kinetics depends on the type of polymer used, skin properties, and the geometry of the Microneedle. In this work, we have modeled physiochemical parameters of microneedle (e.g., Swelling kinetics of polymer) to understand the drug delivery mechanism of swellable microneedles. The three-dimensional finite element model described the diffusion and kinetics in the skin following drug delivery with a swellable microneedle array. The model considers various factors like water uptake, polymer swelling, and drug release. Contact modeling is employed to study the effect of skin viscoelasticity on microneedle. The calculations of the model have been validated against experimental data obtained from the literature. The proposed model was able to describe all the observed phenomena related to drug delivery from swellable MNs. It can be considered as a tool with predictive capabilities, useful in the design and testing of new systems based on swellable MNs.

Figures used in the abstract

Figure 1 : Microneedle array (4X4) inserted into the skin