

Theoretical and Practical Approach for Transdermal Drug Delivery Using Microneedle for Successful Skin Penetration

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Abstract

ABSTRACT: With the advent of micro-electromechanical systems, transdermal drug delivery has been developed to increase skin permeability for drug transport. Among various TDD systems, drug delivery through microneedles is a novel and promising alternative to oral medications and transdermal patches.

The review of the recent research on microneedles design and fabrication has been done and a detailed comparison has been carried out to find the optimum way of designing microneedle array structures for transdermal drug delivery. In this project study, various microneedle structures have been analyzed theoretically as well as through simulation using COMSOL Multiphysics®. Then the study has been carried out to investigate the velocity and pressure distribution in order to study the behavior of the fluid flow inside the microneedle cavity. In this report, the microneedle array interaction while insertion to human skin or soft tissues has been analyzed and simulations has been carried out using COMSOL to verify the structure deformation and fluid interaction with the surface.

For controlled drug delivery, optimized structures of hollow microneedles can be fabricated thereby, increasing the permeability of the skin as well as transdermal transport of fluid molecules or drug. Design and microfabrication of microneedles for biomedical applications is one of the challenging tasks in BIOMEMS to replace hypodermal injections and conventional methods of drug delivery.

Keywords: Skin; Transdermal; Microneedle; COMSOL; Stress

Reference

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Figures used in the abstract

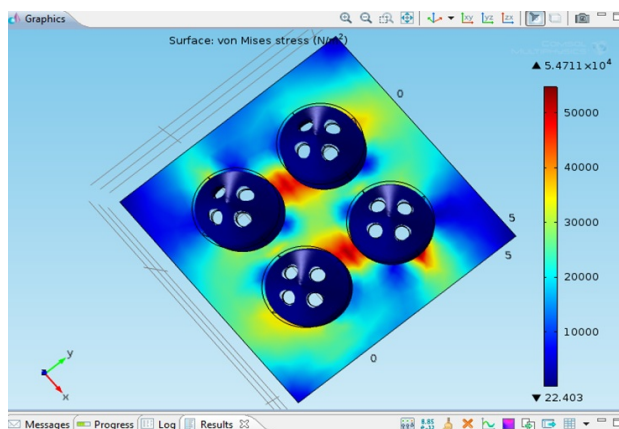


Figure 1: Uniform distribution of microneedle on wafer area

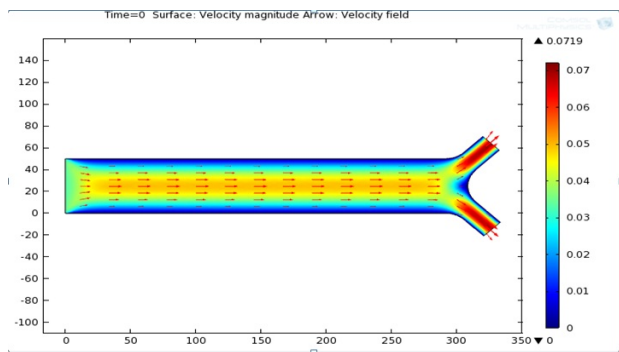


Figure 2: Laminar flow and the arrow represents velocity field

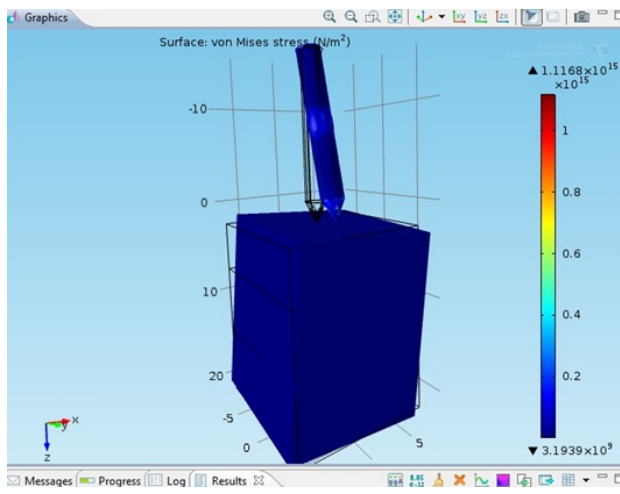


Figure 3: Microneedle interaction with skin having Young's modulus 4.2×10^5 N/m²