DESIGN AND SIMULATION OF SOLID STATE MICROPUMP BASED ON PIEZOELECTRIC ACTUATOR

G.W.S.S. Abesinghe, M.G.C.M. Gunasekara, and S.U. Adikary*

Department of Materials Science and Engineering, University of Moratuwa, Sri Lanka

**Email: suadi@uom.lk*

This research presents the design and simulation of a solid-state insulin micropump based on a piezoelectric actuator for a wearable insulin pump device to be used on the human body. The primary objectives of this design are to minimize the need for frequent dosing, replace oral therapy, and alleviate the discomfort associated with painful injections for individuals with diabetes.

Our research provides an overview of key concepts, the operating principle, and the design considerations of the micropump. The selection of materials, theoretical studies, and the optimization process of the pump were also investigated in our research. Finite element analysis was employed to optimize the design, and the simulations were conducted using COMSOL Multiphysics 5.3a software in the research.

By utilizing the piezoelectric actuator, the proposed micropump demonstrates promising potential for reasonable insulin delivery. The simulations enable the evaluation of various parameters such as actuator performance, fluid flow dynamics, and overall flowrate. The results obtained from the simulations provided valuable insights into the overall performance of the pump and aid in its refinement. The integration of wearable insulin pump devices with this micropump design opens new possibilities for convenient and effective diabetes management.

Keywords: Piezoelectric Valveless Micropump, Piezoelectric Actuator, FEA (Finite Element Analysis), Wearable Insulin Pump Device, Simulation, COMSOL Multiphysics.