

# Blood-mimicking delivery in polygonal structure of inner quadrupletip microneedle with valveless micro-pump

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**Abstract.** This paper presents a titanium quadrupletip micro-needle integrated with a micro-pump with different inner designs, length and diameter of the micro-channels to measure and maximize the velocity flow in the micro-needle as blood delivered into human body. Titanium is used as the material of the micro-needle which are also the common material in manufacturing of micro-needle. The advancement of micro-needle technologies is improved in penetrating human outermost skin, stratum corneum and further to human blood vessels. The micro-needles with channel inner design of circular, square, hexagon, and dodecagon with quadruple tip designs are drawn with inner diameter parameter of 150 $\mu$ m and 100 $\mu$ m with two different channel length which are 10mm and 25mm. The characteristics of blood delivery in geometrically changed inner designs affect the output velocity in microneedle when the micropump is operating. The results showed that, when it is pumped at 0.04m/s, the blood velocity improved by 5.6% than when the pump is increased by 30% of its capacity. This is due to the backflow generated in the micropump.

## 1. Introduction

Delivering or withdrawing blood techniques are obtained either from arteries or veins mostly by using hypodermic needle to penetrate human skin. For hypodermic needle to reach the arteries or veins are surely uncomfortable and painful. The realization of painless needle from mosquito's mechanism of blood withdrawal, lots of research are done to improve the efficiency of the micro-needles for blood delivery from various sizes of needle and designs. Needles are defined as sharp hypodermic needle that has a function to be painless while completing the task of penetrating the human outermost skin to withdraw blood or injecting fluid into the blood stream [1]~[4]. The advancement of the research leads to the technologies of micro-needles in improving the flow and performance which includes attaching micropump at the microneedle [5]. While keeping microneedle in a longer length, the design parameters