

Development of a wirelessly controlled drug delivery implantable chip based on IPMC actuator for cancer treatment

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Abstract

In the present study, the novel implantable drug delivery chip was designed by silicon reservoir and Ionic Polymer Metal Composite (IPMC) actuator integration. The whole design was tested to be biocompatible. The reservoir was developed by high technique silicon lithography and the IPMC strip was attached as the gate of the drug reservoir. The IPMC actuation and subsequently the drug release was controlled by a manipulated communication system based on transmitter and receiver circuits, designed for wireless power transmission. Electromagnetic waves with 2 MHz frequency were for power transmission. The wireless transmission is on the order of 5 cm due to the chip potential to get implanted in the patient's body, near the cancerous organ.

Introduction: Drug delivery systems are divided into two main categories: passive systems and active systems, where the drug release is controlled by an external source. The active systems involve remote controlled drug delivery chips based on silicon, a remarkable technology, which releases a certain dose of drug on demand from outside the body. Both systems are designed to facilitate cancer treatment and prevent patients from getting involved with the chemotherapy's side effects.

Methods and Results: IPMC was fabricated by electroless deposition of nafion as a smart polymer with the ability to bend in low applied voltages. The prepared IPMC was attached to an etched silicon as a single drug reservoir chip. The transmitter section included a microcontroller, a driver, an amplifier and a coil. Electromagnetic waves generated in the transmitter section were captured by the receiver section, converted to electrical voltage and transferred to IPMC actuator to unseal the drug reservoir. Figure 1 shows the schematic of the drug delivery chip with wireless communications.

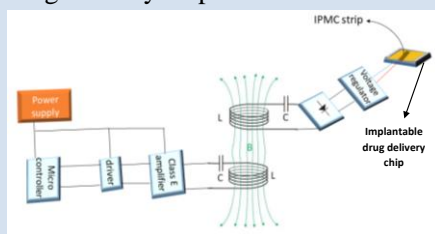


Fig. 1. schematic of the drug delivery chip with the wireless communications

Conclusions: The single reservoir, wirelessly controlled drug delivery chip was designed using IPMC actuator as the gate of the reservoir. The drug was released on demand by generating electromagnetic waves that were converted to electrical voltage and transferred to IPMC actuator in receiver section on the chip.

Key words: IPMC, wirelessly controlled, drug delivery chip, actuator