Drug Delivery Chip

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Abstract—A device based on a microchip which has the ability to administer a drug to an individual. There are multiple mechanisms in which the drug can be delivered to the human body. This device is wireless and has to be surgically placed under the skin or the area of treatment.

I. Introduction

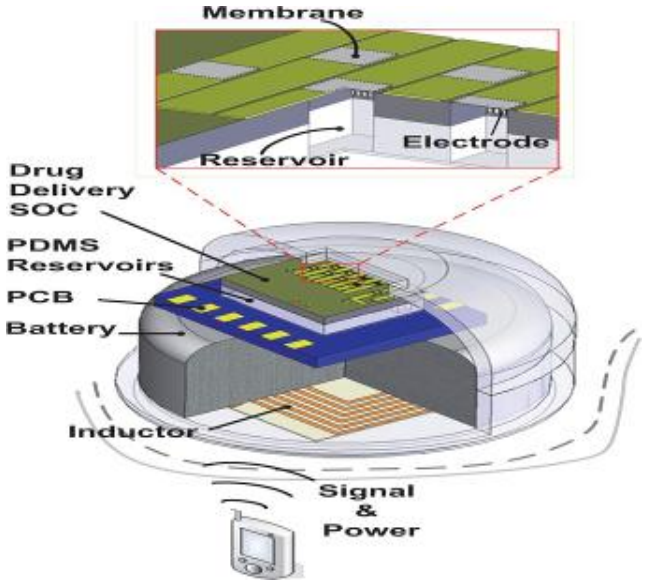
Historically, drugs where given to individuals in the form of pills, liquids, ointments, and/or injections. The idea of a microchip releasing drugs came from Santini, Jr. who used a thin sheet of gold to cover the drug reservoirs. When a certain voltage was reached the gold sheet over a single reservoir would melt away and expose the drug to the human tissue. From there the item was developed even further by Smith. Smith connected the integrated circuit to the drug reservoirs which also included the wireless control. There are currently many different types of drug delivery chips each with their advantages and disadvantages. Drug delivery chips can be separated into two categories; mechanical micro pumps and non-mechanical micro pumps. The difference between to the micro pumps is how they actually pump out the drugs. Mechanical pumps use a mechanism to physically push the drugs out of the well. On the other hand, non-mechanical pumps have to transform one form of energy into kinetic momentum to push the drugs out of the well.

II. Methods

Even thought the mechanisms of how each drug delivery chip works are different, the fabrication of the reservoirs out of the microchip is almost all the same. There is a standard for how the microchips get produced in the factory, so the microchips have to be modified. Since the chips are being surgically implanted into a human the smaller the chip is the better. The chip is thinned to about 100μm, then markers (photoresist) are put on the backside of the chip so the reservoirs can be drilled. The top side of chip is trimmed only on top of the reservoirs to about 200nm (the thin layer that is left is called the membrane). Next, polydimethylsiloxane (PDMS) is added to the bottom of the chip to increase the size of the reservoir. The drug is then added and the bottom is then capped off. All the materials used in making the drug delivery chips are bio-compatible with the human body. In the drug delivery chip there can be other items such as batteries and an inductor.

III. Results

Most of the test trials of the drug delivery chips where conducted *in vitro* or on rats. When tested, the reservoirs only took a total of 1.5 seconds to open (chemical non-mechanical micro pump).



IV. Discussion

First, the drug delivery chip is not intended to be administered for illnesses such as the common cold. The drug delivery chip is aimed at chronic disease such as diabetes, melancholia, epilepsy, etc. One of the limitations of the drug delivery chip is the chip has to be surgically implanted into the body which could cause infection and inflammation. On top of that, some of the mechanisms that are used to push the drug out of the reservoir produce unwanted products such as increase in pH and bubbles. Also, due to the limited space that in provided by the reservoir the drugs will need to be at a higher concentration compared to the other ways the drug is administered to the body. Therefore, the surrounding tissue might be damaged. The drug delivery chip does provide advantages that no other form can. By having the chip implanted it could stop a person from going to the doctor everyday to receive a shot. The chip can also be placed on the exact area that needs the medication, therefore reducing the amount of waste (the volume of the drug that is not absorbed by the body). In the future, hopefully the chip will be able to sense when more of the drug is need and is released automatically.

References

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