

A Study on Medical Applications of MEMS Technology (Bio-MEMS)

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Abstract

This paper consists of the study based on the application of Bio-MEMS in Medical Science. In recent years MEMS have been developed for various domains to ease our day-to-day life and activities. But Bio-MEMS has been one of the best fields that MEMS technology is used to solve modern day problems. And the scope of improvement and development is vast in this field in the future.

Keywords: Bio-MEMS, Medical, Micro pumps, MICROBOTS

INTRODUCTION

Bio-MEMS can be seen in variety of application in medical field and lots of surgical technology is being developed with the help of Bio-MEMS. The size and the function which Bio-MEMS performs at molecular level is what that makes Bio-MEMS in demand in modern day Medical Science. MEMS involves many disciplinary fields of Engineering like Electronics and Communication [1–5], Electrical Engineering [6–12], Mechanical engineering [13–19] and Biotechnology [20] as well.

The application of Bio-MEMS in the Medical science [21] is vast and is still in the developing stage. But as technology develops with time the minute size of these Bio-MEMS is very useful at biological level. The application of Biological level Bio-MEMS is Human Cell diagnosis, cell damage repair and much more. The application of Bio-MEMS in Medical field is vast, but few applications will be discussed in this paper.

Production of Bio-MEMS

The new technology used in the fabrication of Bio-MEMS is a technology that involves the use of mechanical micro tools. The reason for using this method is because of the precision and the effectiveness. The fabrication of most of the Bio-MEMS using non-organic materials such as glass or plastic, but with advancement of technology, manufacturers prefer the use of silicon for the fabrication of Bio-MEMS as it is easy to fabricate, and it is available abundantly and is durable as compared to glass and plastic. Even though many Bio-MEMS use silicon for fabrication, certain applications of Bio-MEMS require the fabrication of Bio-MEMS to use different types of Polymers as it is cost effective and reduced time consumption while fabricating. The main factors why few applications of Bio-MEMS use poly silicon is, as Bio-MEMS is used in medical field it deals with human tissues and protein cells it can block the sensors which use silicon, glass or plastic thereby reducing the effectiveness of the Bio-MEMS and the durability, and we will not get the desired output if we use non-organic materials for the

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fabrication of the required sensors.

Implanting Bio-MEMS

Many Implantable Bio-MEMS have been designed [22] in order to offer better treatment and analysis of ailments. There are many Implantable Bio-MEMS present, but we are going to discuss few of them in this paper.

Micro Pumps

The old and outdated method of delivering narcotics to the human body was either by swallowing them, injecting it in the blood stream or drawing in the drugs via the nose have been used since the early ages of mankind. But with advancement of technology and time Micro Pumps [23] have been developed for delivering narcotics to human body in an effective way. Micro Pumps are micro electronic devices that are used to deliver the narcotics to the human body in a precise and in an effective way and at the right duration of time. The below given diagram shows the narcotics delivery system in Micro Pumps.

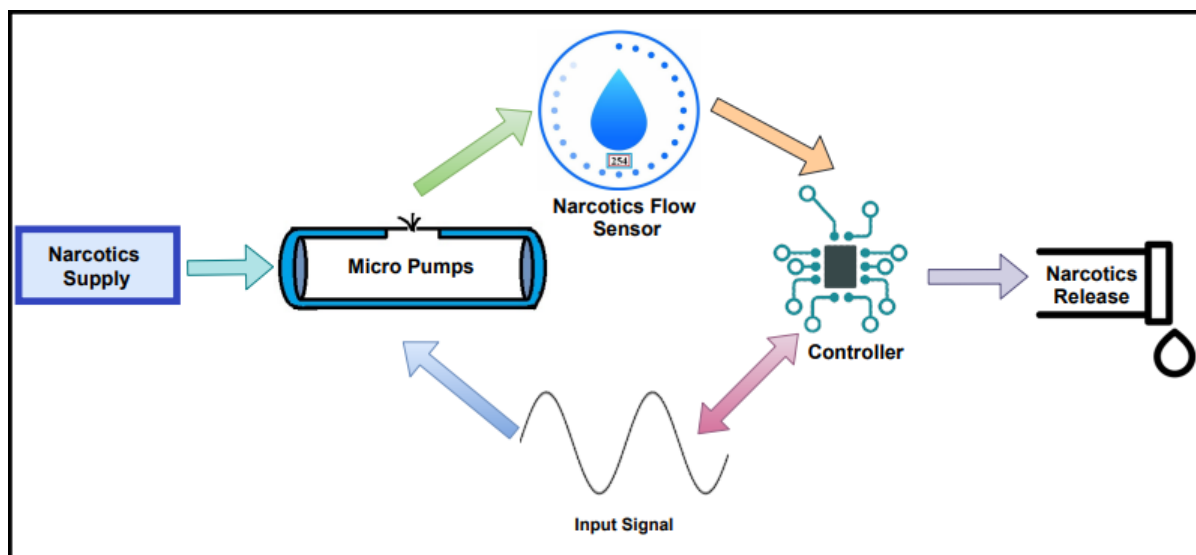


Figure 1. Narcotics Delivery System.

There are two types of Micro pumps (1) Mechanical Micro pumps, (2) Non-Mechanical Micro Pumps.

In the 1st type, the narcotics is pumped into the human body using piezo electric actuator and hence the name. The 2nd type does not have mechanical movement and thus must convert the Non-Mechanical movement to mechanical in order to pump the narcotics into the human body (Figure 1).

MICROBOTS

One of the major applications discussed in this study is about MICROBOTS. MICROBOTS is Bio-MEMS latest application that are used in Medical Science and are considerably small in size that it is injected into numerous parts of the human bodies. The MICROBOTS work in a way that once they are injected to human body, it makes several medical surgeries and procedures less painful and reduces numerous medical complications for patient during and post surgeries. It also helps the patient with the recovery time and reduces any post operation infection. MICROBOTS are very minute in size (in cm) and can be modified to desired size depending upon the location in the body it needs to be injected. MICROBOTS are very applicable in difficult surgeries such as cancer cell removal, bladder stone removal etc. And the future of Bio-MEMS is bright but designing the Bio-MEMS for environment that changes constantly is incredibly challenging with current technology, but numerous procedures are developed to provide solutions for this problem.

Researchers have developed MICROBOTS that can be injected to the body through the human blood stream where the cancer cell is present and using the inbuilt functions can eliminate the cancer cell without harming the host body. These MICROBOTS are genetically modified to attack the tumour and the cancer cells in the body. The MICROBOTS use a unique method of delivering the drugs to the Tumour/Cancer affected part to eliminate and leave the good cells alone without causing any damage to them. This method avoids the patients to undergo weeks of chemotherapy, avoid hair loss, loss of taste and other side effects. The side effect is that it can identify only huge Tumour/Cancer cells present in the body and neglecting small Tumour/Cancer cells in Breasts and Prostate [24–26].

Phase Maker

Phase Maker is an electronic device which is implanted in the human body to provide treatment for problem of rhythm of heartbeat. The heart can beat too quickly or at a slow pace. This electronic device sends an Electrical impulse signal to the atria to get the patient's heart to beat at a normal pace (65–110 BPM). But the conventional size of Phase Maker is very huge and involves lot of electronic elements for manufacturing it. With the advancement of technology Micro Electromechanical System has been able to dramatically reduce the electronic elements and made it more compact than the old device.

With the old technology of the Phase Makers, it had 1 chamber with fixed rate of electrical impulse to the patient heart to stabilize it. On the other hand, Micro Electromechanical System based Phase Maker has 2 chambers with flexible rate of Electrical impulse sent to the human heart to stabilize it. Micro Electromechanical System based Phase Makers are more reliable, stable, and highly effective compared to the 1 chambered Phase Makers. The Micro Electromechanical System based Phase Makers are cost effective and consume less power and gives effective results.

Flexible rate Phase Makers are more in demand rather than Fixed rate Phase Makers because the Flexible rate Phase Makers have the potential to match the human body's cardiac needs, keeping in mind the cholesterol level as well. As in the case of Fixed rate Phase Makers, it provides fixed rate of electrical impulse to the human body regardless of the cardiac needs of that particular human body. Flexible rate Phase Makers are very helpful for those people whose body fat percentage is very high and the heart does not beat at the required rate even after a heavy workout. Peak Endocardial Acceleration (PEA) Sensor and Activity sensor are used in Flexible rate Phase Makers to provide electrical impulse based on the requirement of that particular human body [27-28].

Advantages of Bio-MEMS

- Effective drug delivery method
- Performs complex tasks without harming the host body regardless the size of the element.
- Reduced the size of Phase Makers and made it more compact.
- Can perform many functions inside the human body at regular intervals of time either fully automatic or Semi-Automatic and provides regular feedback.

CONCLUSION

The importance of Bio-MEMS is Medical Science is very vast and is gaining popularity very quickly because of the tasks it can perform in the medical field. It is fully accurate and exceptionally reliable. There are many applications of Bio-MEMS in the field of medical science and few of them has been explained in this paper to help us understand the overview of Bio-MEMS applications. The scope of development in Bio-MEMS is huge and new research is being done to find new applications to modify the current technology to make Medical Procedure easy and cost effective for the future.

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