International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 5, July-August 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Bioelectronics - The Revolutionary Concept

Anshika Gupta

Department of Mechatronics Engineering,
Mukesh Patel School of Technology Management and Engineering, NMIMS, Mumbai, Maharashtra, India

ABSTRACT
Electronics in medical sciences has been an emerging field of study and has evolved a lot. Bio electronics is a somewhat new branch that can provide more effective and convenient solutions by revolutionizing the scope of medicine forever. It involves electronic devices that can be consumed furthermore after going inside the body, capable of assisting in various procedures like a diagnosis, surgical assistance, etc. This paper focusses on delivering the fundamental concept of edible electronics, how is it helpful, its extent of application, and its challenges.

KEYWORDS: *Edible Electronics, Inject able electronics, Bioabsorbable Electronics, Soft electronics*

How to cite this paper*:* Anshika Gupta "Bioelectronics - The Revolutionary Concept" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-5, August 2020, pp.979-981, URL: www.ijtsrd.com/papers/ijtsrd33022.pdf

IJTSRD33022

INTRODUCTION

Today we are surrounded by electronics everywhere, and it exists in many forms such as a handy device like mobile, a wearable like a watch, even an instilled device, and many more. They have been advancing continuously in the field of health for diagnosis majorly but can also be made appropriate for other internal purposes.

Bio-electronics are an engineering challenge in itself because of the obstacles encountered in making it safe and assuring whether the device would be capable of completing the desired task. The foundational elements in this field can be microelectronic devices, invented back in the 1950s. Then, progressions in technology made the system more flexible and adaptive.

The interaction of electronics with the human is broad, with a lot of different aspects. It can be classified into 3 types which lay the foundation to the aspirations used in the concept of edible electronics which a fairly new concept.

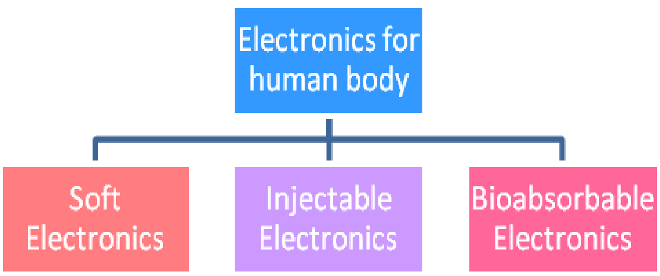

Figure 1: Classification of electronics in human body.

The description of the three are given below.

I. Soft Electronics

It mainly focusses on making electronics stretchy and more flexible (biocompatible) like the human body. A lot of experiments with different materials carried out to make the electronics adequately stretchy to fit in the human body parts, replacing the damaged part or providing support to the existing ones. Finally, a heterogeneous combination of silicon in kinds with soft elastomers was determined to be perfect for the application.

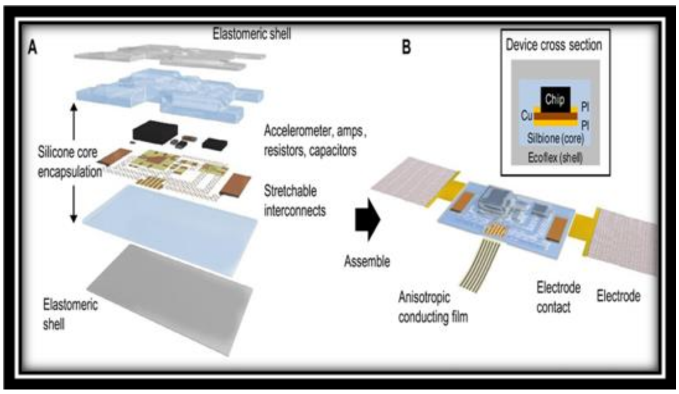

Figure 2: components arrangement in soft electronics tattoo

Usually, piezoelectric or thermoelectric thin films or ribbons generate the power for the working requirements. These skin-like soft electronics can be put as tattoos on the skin for providing a measurement of parameters outside the skin like skin moisture, temperature, etc as well as inner parameters like functioning on veins, arteries, etc. Also, they can simulate and monitor various brain functions, using silicon nanoribbon transistors along with amplifiers. The applications of this not limited to the above but many more.[2]

II. Injectable Electronics

This type, the electronic tools are ultra-flexible, such that they can be injected into the body without any consequences using a syringe. They are also known as non-invasive and seamless 3D interpenetration. [3,4]

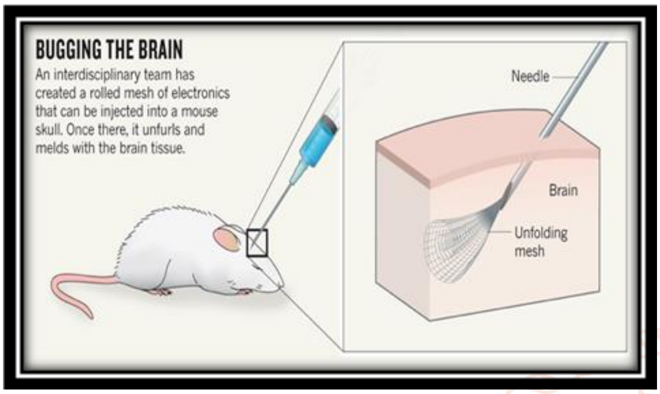

Figure 3: Injectable electronics on a mouse brain

This consists of a macrporous mesh, which is about 1000 times more flexible than the ordinary flexible electronics. It is fabricated from a blend of semiconductors, metals, and polymers, usually Silicon Nanowire Field-Effect Transistors. Then the material is swirled to fit in the metal or glass needle for injecting into the desired place. It generally regains 80% of its original shape to occupy the available space. This could be used to understand the tissue working as well as imaging in the intricate, difficult to access parts.[5]

III. Bioabsorbable Electronics

Bioabsorbable electronics consists of both ingestible (edible) and implantable electronics. In initial times, the fractured bones and other joint replacement were done using typical mechanical devices that were extremely rigid and did not give enough stretching ability for the comfortable movement. Later this problem was solved by the use of implantable electronics, that were flexible enough to be incorporated in the required space as well as had an additional feature of diagnosis also.[6]

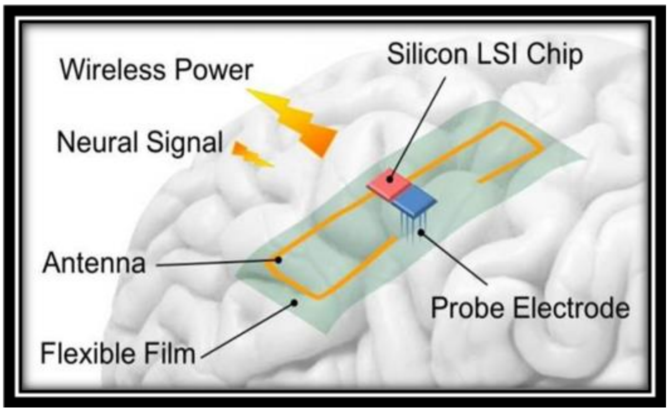

Figure 4: Implantable fixture in the brain.

The use of implantable electronics is not only limited to the aforementioned traditional simple uses, but also it may assist in critical functions like improving the hearts functioning (pacemaker), detection brain functioning through neural signals, etc.

Edible electronics is the other part of bioabsorbable electronics in which the electronics devices or tools are made with ingestible sensors layered between thin silicon capsule or films, usually easily swallow able. The market for smart pills was roughly about $1.56billion valuation and is expected to rise to a staggering $8.98billion by 2024.[7]

Figure 5: Smart pill having a camera for GI tracking.

Usually these pills consist of sensors, cameras, microcontrollers, and a wireless transmitter so that the sensor or the camera could give the useful information to the user or medical experts via an app or screen. All the components are put together in a medical seal so that they can be swallowed. The first major drawback is the power limitations, that at present can only be improved using electronics but cannot be used because of the toxicity and rigidness. So currently biologically derived materials like organic electrodes consisting of natural melanin pigment are used, derived from fishes or on-board Ni-Cd batteries, which can power the device up to 2 hrs and 72 hrs respectively. The various other challenges are the threat of infection and toxicity. But despite of all these this technology has a huge potential to many medical procedures easier and less painful, along with potentializing the ability to reach the most complicated places inside the human body.[8]

Conclusion

Combining both biology and electronics can help in a better understanding of both the field along with helping to know their limitations and loop holes. Currently the most needed advancement in this field is making the devices more biocompatible, flexible and eco-friendly.

References

[1] B. M. K. Prasad, Karan Singh, Shyam S. Pandey, Richard O'Kennedy, "Communication and Computing Systems" Proceedings of the 2nd International Conference on Communication and Computing Systems (ICCCS 2018), December 1-2, 2018, Gurgaon, India.

[2] J. A. Rogers, "Soft electronics for the human body," 2016 46th European Solid-State Device Research Conference (ESSDERC), Lausanne, 2016, pp. 21-22, doi: 10.1109/ESSDERC.2016.7599579.

[3] Harvard University. "Injectable electronics offer powerful new tool in understanding how retinal cells

work." Science Daily. www.sciencedaily.com/releases/2018/06/180628151755.htm (accessed July 6, 2020).

[4] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4591029/

[5] https://www.materialstoday.com/biomaterials/news/injectable-electronics-fit-right-in/

[6] G. Becker, A. Calvis, L. Hazlett, M. Verzi and M. Paliwal, "Bioabsorbable polymeric fracture fixation devices aim to reduce stress shielding in bone," 2014 40th Annual Northeast Bioengineering Conference (NEBEC), Boston, MA, 2014, pp. 1-2, doi: 10.1109/NEBEC.2014.6972727.

[7] https://www.marketsandmarkets.com/PressReleases/smart-pill.asp

[8] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6503252/#:~:text=Edible%20electronic%20devices%20are%20orally,treat%20many%20types%20of%20diseases.&text=Distributed%20computing%20platforms%20can%20provide,medical%20devices%20in%20ambulatory%20patients.