A Study on Energy Source in Bio Batteries

1Sasikala. T, 2Suresh. B

1,2Assistant Professor
Department of Electronics & Communication Systems, VLB Janakiammal College of Arts and Science, Coimbatore, Tamil Nadu, India.

Abstract: A bio-battery is an energy storing device that is powered by organic compounds, usually being glucose, such as the glucose in human blood. When enzymes in human bodies break down glucose, several electrons and protons are released. Therefore, by using enzymes to break down glucose, bio-batteries directly receive energy from glucose. These batteries then store this energy for later use. This concept is almost identical to how both plants and many animals obtain energy. Bio-batteries are alternative energy devices based on bio-electro catalysis of natural substrates by enzymes or microorganisms. Although the batteries are still being tested before being commercially sold, several research teams and engineers are working to further advance the development of these batteries. Bio-batteries have a very bright future ahead of them as test productions and research have been increasing over recent years.

IndexTerms: Glucose, Enzymes, Bio-Batteries.

I. INTRODUCTION
The principles of the bio battery are based on the energy conversion mechanism in living organisms. However, in order to create the bio battery, several technologies needed to be developed. These include immobilization of enzymes that are normally incompatible with carbon and metal electrodes, electrode structures, and electrolytes. Mechanisms used in living organisms, are not only friendly to the environment but is also likely to be of practical use as an energy source.

II. LITERATURE SURVEY

The first Bio Battery

The Bio Battery, based on the work of Professor Kenji Kano (Kyoto University), is a type of battery that uses energy sources such as carbohydrates, amino acids and enzymes from a variety of sources. Anode consists of sugar-digesting enzymes and mediator, and the cathode composes of oxygen reducing enzymes and mediator. When sugar is added to the mixture, the anode garners the electrons and hydrogen ions. When the battery generates power, the protons travel to the cathode through the electrolyte to combine with the oxygen to produce water. Since the biocatalysts (enzymes) are very selective catalytically, the miniaturized bio-fuel cell could in principle be fabricated as a membrane-less fuel cell.

The Micro Fluidic BFC

Lim and Pal more at the Brown University have reported a micro fluidic BFC with many channels connected in parallel. In this configuration, the design allows streams of fuel and oxidant to flow in parallel within a micro channel without using a membrane as a separator and showing a power density >25 uW/sqcm. Several potential applications of BFCs have been reported or proposed in the literature for implantable devices, remote sensing and communication devices as a sustainable and renewable power source. However, there are no BFC design formats or templates that allow for the production of a working device with a size on the order of 1 cc, which are needed for several “real world” applications.

Enzyme Based Bio Battery

Enzyme based BFC is very attractive, however it has been shown that electron flow is too slow to make a viable fuel cell. This is due to the difficulty for enzymes to attain direct electrical contact with the electrodes of the cell and catalyze reactions effectively. The principles of the bio battery are based on the energy conversion mechanism in living organisms. However, in order to create the bio battery, several technologies needed to be developed. These include immobilization of enzymes that are normally incompatible with carbon and metal electrodes, electrode structures, and electrolytes. Mechanisms used in living organisms, are not only friendly to the environment but is also likely to be of practical use as an energy source. Sony has focused on these advantages since 2001 and has developed an electrical power generation device that uses mechanisms similar to those in living organisms.

Bio battery using Human Blood

In 2003, Japanese researchers at Panasonic’s Nanotechnology Research Laboratory announced that they were working on extracting power from blood glucose. At the time, they were using enzymes -- a frequent component of bio-batteries due to their catalytic properties -- to retrieve electrons from glucose. Two years later, a different Japanese research team, this one from Tohoku University, announced that they had succeeded in creating a small “biological fuel cell.” Their cell could be used to power small
medical devices, such as an implant to measure blood sugar levels in diabetics. Future versions of such technology could, like RPI's nano composite paper, be used to power an artificial heart with the blood that flows through and around it.[3]

**Bio battery using Human Urine**
In August 2005, scientists in Singapore developed a battery that uses human urine as its fuel. Despite its potentially off putting power source, the battery has a wide variety of applications. The researchers said that their device was the size of a credit card and could form the basis of inexpensive, disposable disease-testing kits. (Urine is already used to detect drugs and some diseases.) What makes the device particularly useful is that it integrated the battery and testing device into one disposable chip. Imagine a one-time use home-testing kit for diseases like cancer or hepatitis. One of the researchers involved in the project said that the battery could also be adapted to provide a brief charge to other electronic devices. A lost hiker might use one to power a cell phone for a short emergency call [4].

**Bio Battery using Carbohydrates**
Sony Corporation (Japan) has developed a bio-battery with a peak power output of 50 mW, which could power a portable MP3 player. On August 23, 2007 Sony announced the development of a bio battery that generates electricity from carbohydrates (sugar) utilizing enzymes as its catalyst, through the application of power generation principles found in living organisms.

**Recent Bio Batteries using Blood and Sweat**
“ Its flexible, it can be shaped or folded, & can poke a hole in it & it still works” says chemist ROBERT LINHARDT, a member of research team that developed the new bio battery made from paper & carbon nano tubes working at RENSSELAER POLYTECHNIC INSTITUTE IN NEW YORK, easily implanted directly under the skin unlike metal batteries.

**The Latest Bio Battery using Virus**
Scientists engineered a virus at the “MIT” that could form a battery 3 times more powerful than those found in gadgets today. PROBLEM: virus can mutate & can spread by air. So when these batteries run our laptop we really have to watch which virus to remove.

**Bio Battery using Bacteria**
Bielefeld iGEM team is to develop an environmentally friendly bio-battery (Microbial fuel cell -- MFC), which directly transforms bacteria into energy. Batteries such as these work in the same way as conventional batteries, but with one difference. The MFC consists of two separate units, the anode and the cathode components, just like the batteries now in current household use. A partly permeable membrane separates the two areas. In contrast to conventional batteries, however, there are bacteria in the anode area of the bio-battery instead of electrolytes. These break down substrates, in this case glucose, in a metabolic process. This produces electrons that after starting from the anode are finally delivered in an external loop to the cathode. The external circuit is then the one with the battery-powered application, for example, for lights or small motors. In this way, bacteria can produce electric energy. The bio-battery offers an array of advantages. Due to their simple construction they can be used in regions where there is shortage of electricity, for example, such as in developing countries. An advantage that the bio-battery has over other regenerative energy sources, such as solar and wind power is that they are not dependent on the weather. In the case of bio-batteries, the more nourishment the bacteria receive the more energy they produce. What is more, in theory bacteria are an inexhaustible source of energy as they multiply quickly when supplied with substrates.[5] A new study reveals how bacteria reduce electricity when proteins in their cell membranes come into contact with a mineral surface. Scientists have known for some time that a family of marine bacteria known as Shewanella oneidensis, found in deep ocean sediments and soil, can create electrical currents when exposed to heavy metals like iron and manganese. In a study published (March 25,13) in the journal Proceedings of the National Academy of Sciences, researchers show that these proteins can ferry electrons across a membrane at a rate fast enough to produce the energy the bacteria need to survive[6],[7].

**III. FEATURES&SPECIFICATIONS**
The bio batteries are stacked in single or a multi cell prototype. The packaging aspects of the bio-fuel cells are also analyzed and the found that relatively little work has been done in the engineering development of bio-fuel cells. The single cell and six cell bio battery packaging.

**IV. CONCLUSION**
The Bio batteries are High performing, stable, and reproducible enzymatic fuel cell technology developed over last 5 years. The Scaled-up demonstration of Bio-Battery powering electronic circuit (performed at both Power Sources and Army Science Conf’s). Fully-integrated Bio-Battery charging prototypes are already developed. Funding secured from multiple Department of Defense (DOD) agencies for multiple target applications over the next 2-3 years. While many exciting announcements have been made in the field of bio-batteries, it may be some time before we see them replacing nickel-cadmium, lithium-ion or the several other types of traditional batteries. Even so, the small, flexible, long lasting and environmentally friendly battery technologies discussed here show the great possibilities researchers see in bio-batteries, especially for the field of medicine The technology generates electricity by turning shredded paper into sugar which in turn is used as fuel. If brought to market, the innovation could allow the public to top up the power of their mobile devices using waste material. Compared to conventional batteries, such as lithium batteries, bio-
batteries are less likely to retain most of their energy. This causes a problem when it comes to long term usage and storage of energy for these batteries. However, researchers are continuing to develop the battery in order to make it a more practical replacement for current batteries and sources of energy. The bio-batteries are environmentally friendly as they did not use harmful chemicals or metals. With that in mind, scientists seem to be exploring every possible option in bio-battery and fuel-cell technology. They serve as a new form of energy that is proving to be environmentally friendly, as well as successful, in producing and reserving energy. Although the batteries are still being tested before being commercially sold, several research teams and engineers are working to further advance the development of these batteries.

REFERENCES