Device

Wearable healthcare devices based on printable electrochemistry

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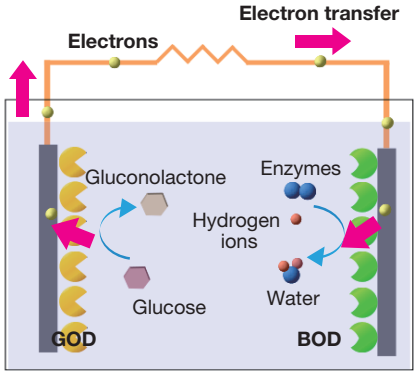
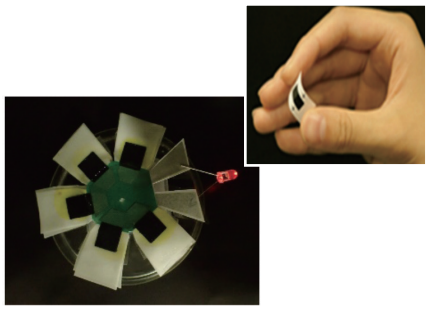
Purpose of Research

To develop thin biological information monitoring devices (wearable healthcare devices) equipped with self-driven biofuel cells, which generate electric energy at the same time as monitoring by using the biological substances found in sweat and urine. We will use advanced printing technologies to make wearable devices significantly thinner, lighter, more productive, and less expensive than the wearable devices that are already on the market, and we will make them able to catch the first signs of diseases, assist in day-to-day health management, prevent lifestyle diseases, and help manage other healthcare issues by measuring various vital signs (such as activity level, pulse (heart rate), and amount of sweat).

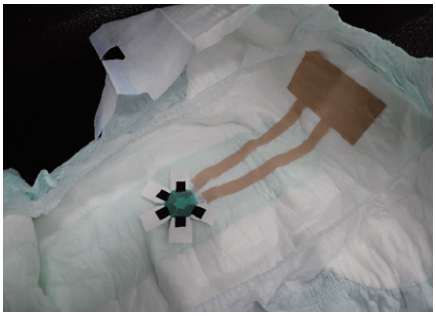
Summary of Research

This technology offers a mechanism in which the device serves as both the power source and the sensor. The device reacts with enzymes to generate electric energy using substances in body fluid such as glucose, and then it uses that energy to send signals from a transmitter. Furthermore, the devices are composed of inexpensive materials, such as paper, so they can be manufactured with a simple printing process.



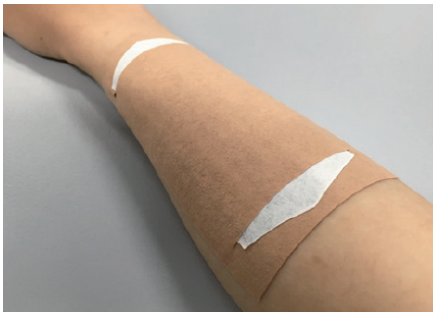


Diaper battery



5 cells in series (0.34 mW)

Bandage battery



4x4 cells are arrayed (1 mW)

Comparison with Conventional or Competitive Technologies

We are proposing new self-driven wearable devices that contain a power generator that offers high biological compatibility and is easy on the human body, as well as being completely environment-friendly, convenient, and inexpensive.

Expected Applications

- Day to day health management and prevention of lifestyle diseases
- Prevention of heat stroke and measurement of fatigue level during sport activities and mountain climbing
- Monitoring of the health of workers in special working environments
- Reduction of the burden on caretakers by embedding the devices in diapers

Challenges in Implementation

We have confirmed that the urinal sugar cells are able to generate electric energy and wirelessly transmit data by using artificial urine. In the future, we need to implement and evaluate the devices in diapers.

What We Expect from Companies

We believe this technology will be beneficial for companies developing biosensors and those seeking to expand their businesses into the healthcare field.
We hope to collaborate with companies that have the technologies to communicate with wearable devices as well as companies that focus on integrating technologies into IoT systems.

Points

- **Enables measurement of the level of biological substances**
- **Costs less but has better performance than other methods of energy harvesting**
- **Simple, safe structure and disposable as it is made of paper**

Future Developments

January 2016 to March 2021
Material development → Manufacture and evaluation technology development → Mounting technology development
(We are planning to demonstrate the devices in the year of the 2020 Tokyo Olympics and Special Olympics, which is the last year of the A-STEP Project)
We always welcome ideas for new applications and proposals for collaborative research.

■ Associated System:
JST Adaptable and Seamless Technology Transfer Program through Target-driven R&D
A-STEP Strategic theme-focused type
(Project period: January 2016 to March 2021)
■ Partners: Tsukuba University, Riken, and other institutes
■ Prototype: Completed