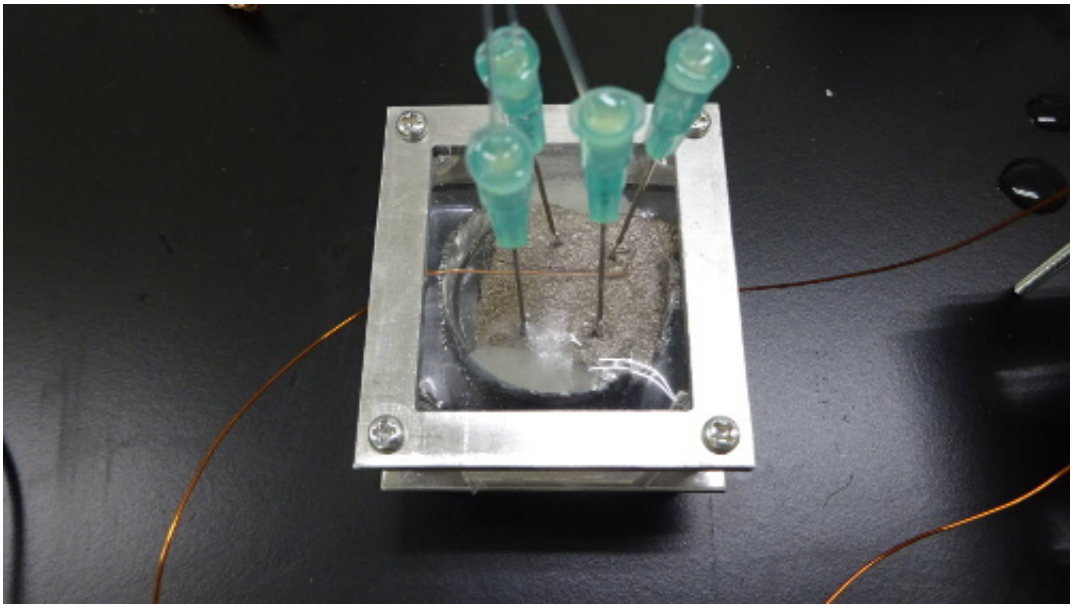
Rays provide power for an electric generator

May 31 2016, by Jens Wilkinson



A cell made from a torpedo ray's electric organ. Credit: RIKEN

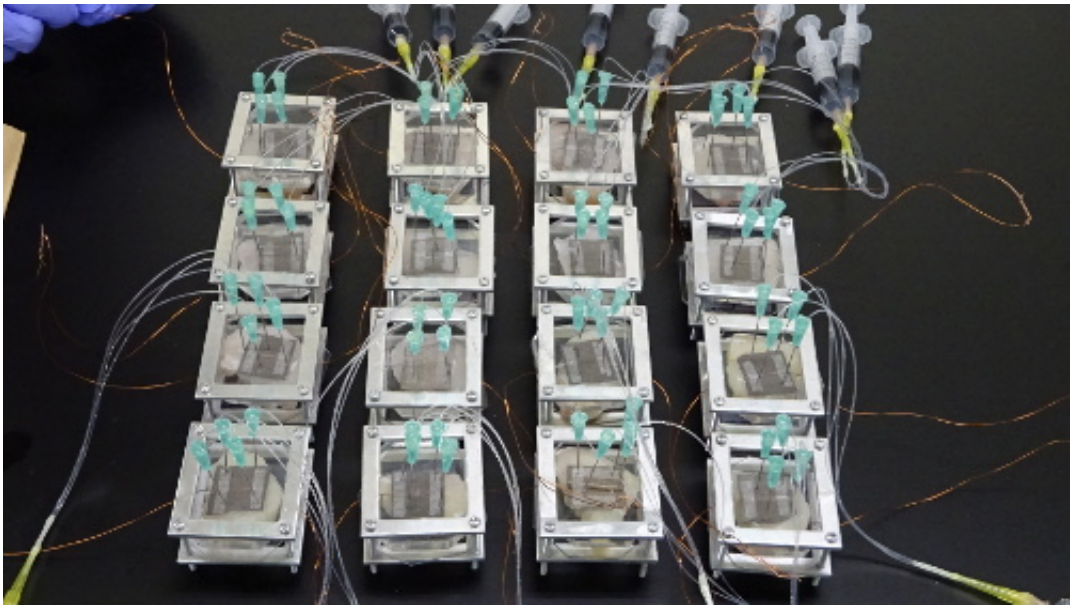
Scientists from the RIKEN Quantitative Biology Center in Japan removed the electric organ from a torpedo and chemically stimulated the organ by injecting a solution of the neurotransmitter acetylcholine though a syringe. They were able to achieve more than a minute of continuous current, with a peak voltage of 91 mV and 0.25 mA of current. By increasing the number of syringes, they achieved a peak voltage of 1.5 V and a current of 0.64mA.

The environmental impact of electric power generation is a pressing international concern. There are mandates to reduce the environment

impact of power generation, leading to a push away from conventional thermal and nuclear power. Recently, biofuel cells such as glucose fuel cells and microbial fuel cells have been developed to meet these mandates. However, the performance of these fuel cells remains inferior to conventional systems.

Nature, researchers recently found, may be able to teach us a better way. Scientists from the RIKEN Quantitative Biology Center (QBiC) in Osaka began work to develop a new type of electricity generator, based on the knowledge that electric rays known as torpedoes can beat other systems by generating electric power with near 100% efficiency. The torpedo has electric organs with densely-aligned membrane proteins that convert the chemical energy of adenosine triphosphate (ATP) into ion transport energy, and a nervous system that controls the whole process.

QBiC's Yo Tanaka and his collaborators thought the principle used by the fish might be applied to make a breakthrough power generator. Their experiments, reported in *Scientific Reports*, artificially reproduced and controlled this phenomenon.



A collection of cells. Credit: RIKEN

They began by looking at what happens in a live electric ray. Tanaka says, "When we used physical stimulation of a live torpedo, we detected less than 10 milliseconds of pulse current with a peak voltage 19 V and current of 8 A in the electrical response. Using this pulse, we found that we were able to store enough electricity to light up LED light or drive a toy car."

Then, in an attempt to generate more electricity, they removed the electric organ from a torpedo and chemically stimulated the organ by injecting a solution of the neurotransmitter acetylcholine though a syringe. They were able to achieve more than a minute of continuous current, with a peak voltage of 91 mV and 0.25 mA of current.

Tanaka continues, "By increasing the number of syringes, we achieved a peak voltage of 1.5 V and a current of 0.64mA. In addition, we found that it is possible to repeat power generation and keep the organ functional for up to one day." By combining a fluid control device to control the stimulation as is done by the torpedo's own nervous system, they were able to generate and store electricity with a peak voltage of 1.5 V and 0.25 mA of current.

Tanaka says he hopes the research will be a first step towards a future high-efficiency power generator that uses ATP directly and could lead to a modern, ultra-clean electric power generator.

More information: Yo Tanaka, Shun-ichi Funano, Yohei Nishizawa, Norihiro Kamamichi, Masahiro Nishinaka & Takehiko Kitamori, "An electric generator using living Torpedo electric organs controlled by fluid pressure-based alternative nervous systems", *Scientific Reports*,

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Provided by RIKEN