RESEARCH NEWS

Bacterial Batteries

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Dr. Ken Nealson, a geobiologist at the University of South California, along with his research team is developing a bacterial fuel cell with a variety of applications including biosensors to insect-like drones for combat surveillance to making pacemakers for cardiac disorders.

A bacterial fuel cell is a device which converts chemical energy into electrical energy by the catalytic action of the microorganisms. It consists of anodic and cathodic compartments, separated from each other by a cation specific membrane. The microbes produce protons and electrons in anaerobic conditions. The electrons are transferred to the electrode through an external circuit while the protons are transferred across the membrane. This transfer leads to the generation of electricity.

The microbe used by Ken Nealson and his team is *Shewanella oneidensis* MR-1. First discovered by Nealson, *S. oneidensis* MR-1 is a kind of microbial superhero. In addition to generating electricity, MR-1 and its relatives can "breathe" metal, clean up toxic residue in water and even keep brass, iron, copper and aluminum corrosion free.

The few prototypes which have been developed are able to generate electricity of the order of a few milliamps. This is very little, in regards to the proposed applications. To improve upon the efficiency of the fuel cell the team used a number of combinations. Some of these included, either replacing the fuel cell membrane or different components with better parts or altering the gene responsible for

electricity production to give better results. Nealson along with Steven Finkel and Byung-Hong Kim lead the team for biological and genetic solutions. Nealson identified the gene in MR-1, which is responsible for generating power, and by creating altered strains of the gene, he aims at getting better results. The team also improved the production by changing the culture conditions from liquid to solid which resulted in greater electricity generation.

Dr. Finkel, meanwhile by using genetic engineering, is turning 'on' and 'off' the genes involved in the process of electron transport chain of the microorganism, thus increasing the electron output. Thus better results are expected. He even postulates that the use of proton-rich carbon source, if used can give larger production of electrons hence generating more electricity. But this poses a problem of high acidity in the media which can ultimately be fatal to the organism.

This technique, although still in its sub-nascent stage, promises cleaner, renewable and cutting-edge alternative energy source. With the fast rate of depletion of natural resources, these bacterial batteries offer us a new direction.

References

- 1 USC College: News: December 2006: Microbial fuel cell www.usc.edu/schools/college/news/december_2006/fuel.html-27k