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Implantable biofuel cells operating *in vivo*: Potential power sources for bioelectronics devices from basic research to practical applications

Implantable devices harvesting energy from biological sources and based on electrochemical transducers are currently receiving high attention. The energy collected from the body can be utilized to activate various microelectronic devices. This talk is an overview of the recent research activity in the area of enzyme-based biofuel cells implanted in biological tissue and operating *in vivo*. The electrical power extracted from the biological sources presents use for activating microelectronic devices for biomedical applications. While some microelectronic devices can work within a fairly broad range of electrical operating conditions, others, such as pacemakers, require precise voltage levels and voltage regulation for correct operation. Thus, certain classes of electronic devices powered by implantable energy sources will require careful attention not only to energy and power considerations, but also to voltage scaling and regulation. This requires appropriate interfacing between the energy harvesting device and the energy consuming microelectronic device. The talk focuses on the problems in the present technology as well as offers their potential solutions. Lastly, perspectives and future applications of the implanted biofuel cells will be also discussed. The considered examples include a pacemaker and a wireless signal transfer system powered by implantable biofuel cell extracting electrical energy from biological sources. The design of implanted biofuel cells operating *in vivo* promises for future various medical electronic implants powered by implanted biofuel cells and resulting in bionic human- machine hybrids. Aside from biomedical applications, one can foresee bioelectronic self-powered "cyborgs" based on various animals which can operate autonomously using power from biological sources and used for environmental monitoring, homeland security and military applications. In all bioelectronic systems, regardless their applications and complexity, the power sources will be highly important and implanted biofuel cell are promising devices for providing electrical power extracted from the internal physiological resources.

Biography

Evgeny Katz received his PhD in Chemistry from the Frumkin Institute of Electrochemistry (Moscow) in 1983. He was a Senior Researcher at the Institute of Photosynthesis (Pushchino), Russian Academy of Sciences (1983-1991), a Humboldt Fellow at the Technische Universität München (Germany) (1992-1993), and a Research Associate Professor at the Hebrew University of Jerusalem (1993-2006). Since 2006, he is Milton Kerker Chaired Professor at the Department of Chemistry and Biomolecular Science, Clarkson University, NY (USA). He has (co)authored over 400 papers in the areas of bio-computing, bioelectronics, biosensors and biofuel cells. Thomson Reuters included him in the list of the world's top 100 Chemists over the past 10 years as ranked by the impact of their published research. He was also included in the list of top cited chemists prepared by the Royal Society of Chemistry with the worldwide rank 378 based on his Hirsch-index, which is currently 81.

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