Implantable Sensors for Visual Prostheses

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The World Heath Organization estimates that more than 3 million people suffer from blindness caused by degeneration of the photoreceptors in the retina, typically from diseases such as age-related macular degeneration (AMD) or retinitis pigmentosa (RP). That number is expected to rise to more than 5 million by 2020, driving the development of retinal prostheses.

Inspired by the success of Cochlear implants, which restores the hearing for the deaf, research efforts worldwide are developing visual prostheses aimed at restoring vision for the blind. Several recent developments from research teams and industrial developers working on visual prostheses have raised hopes in retinal implants and other strategies for restoring vision to blind individuals. Intraocular retinal implants developed by Second Sight have been chronically implanted in 5 patients over the past two years in a FDA approved IDE study. Figure 1 shows a concept image of an intraocular retinal prosthesis.

By integration of sensors with those medical implants, the device performance in vivo can be monitored. The sensor systems permit early corrective therapy or provide the feedback in order to control the devices to form so called “Smart” implants. Information gained from such monitoring also provides insight into the strengths and weaknesses of the design of the device and enables improvement in future product design.

This paper concentrates on recent developments in sensors for the neural prostheses, especially Retinal prosthetic devices. The importance for in-vivo and in–vitro pH measurements as well as a solid-state pH sensor will be demonstrated. The micro-electrode arrays with nanometer scaled surface roughness for the measurements of electrolyte/electrode interface impedance will be discussed. The challenges in the development of implantable sensor systems, especially using MEMS technology for the medical implants will be discussed.

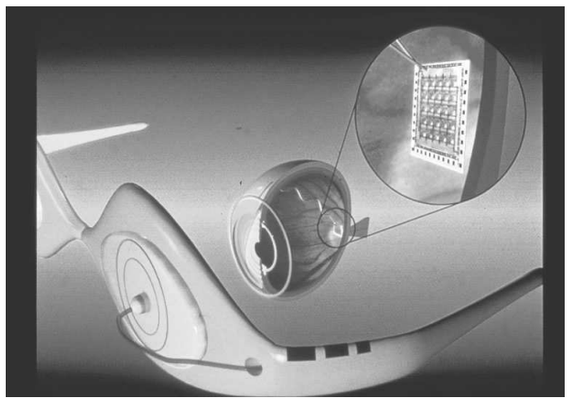

Figure 1. A concept image of an intraocular retinal prosthesis.