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Microsystems Technology for Retinal Implants[1]

JAMES WEILAND, Doheny Eye Institute

The retinal prosthesis is targeted to treat age-related macular degeneration, retinitis pigmentosa, and other outer retinal degenerations. Simulations of artificial vision have predicted that 600-1000 individual pixels will be needed if a retinal prosthesis is to restore function such as reading large print and face recognition. An implantable device with this many electrode contacts will require microsystems technology as part of its design. An implantable retinal prosthesis will consist of several subsystems including an electrode array and hermetic packaging. Microsystems and microtechnology approaches are being investigated as possible solutions for these design problems. Flexible polydimethylsiloxane (PDMS) substrate electrode arrays and silicon micromachined electrode arrays are under development. Inactive PDMS electrodes have been implanted in 3 dogs to assess mechanical biocompatibility. 3 dogs were followed for 6 months. The implanted was securely fastened to the retina with a single retinal tack. No post-operative complications were evident. The array remained within 100 microns of the retinal surface. Histological evaluation showed a well preserved retina underneath the electrode array. A silicon device with electrodes suspended on micromachined springs has been implanted in 4 dogs (2 acute implants, 2 chronic implants). The device, though large, could be inserted into the eye and positioned on the retina. Histological analysis of the retina from the spring electrode implants showed that spring mounted posts penetrated the retina, thus the device will be redesigned to reduce the strength of the springs. These initial implants will provide information for the designers to make the next generation silicon device. We conclude that microsystems technology has the potential to make possible a retinal prosthesis with 1000 individual contacts in close proximity to the retina.

[1]Department of Energy Office of Science