Responses of retinal ganglion cells to electrical stimulation with a subretinal photovoltaic prosthesis

(Talk #3)

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This presentation will discuss our recent progress in evaluating the efficacy of silicon-based solar cells in evoking retinal ganglion cell (RGC) responses by electrically stimulating the photoreceptor side of an isolated retina. The photovoltaic prosthesis was designed by the Biomedical Electronics Translational Research Center, National Chiao Tung University, Taiwan and fabricated by the Taiwan Semiconductor Cooperation (TSMC). The prosthetic chip is equipped with a centrally located 8x8 CMOS sensors array, fabricated with 0.18 um line width technology of TSMC. An independent output electrode is accompanied by individual sensor and corresponding return electrode. The chip is powered by on-chip integrated solar cells in the periphery. The chip is uniquely embedded with a divisional-power-supply-scheme (DPSS) circuit, which provides power alternately to a subset of electrodes at a time with all the electricity. The chip was investigated systematically in vitro to verify the electrophysiological response of RGCs from isolated rabbit and mouse retinas using a multi-electrode array. With this chip, RGCs were successfully activated by electrical stimulation of the retinal neural network. Reliable activation of RGCs by electrical stimulation in vitro using a subretinal photovoltaic prosthesis with DPSS design demonstrates its potential and could be developed into a power-free device able to restore vision in the future.