BIO-COMPATIBILITY OF THE POLYIMIDE-BASED MICROELECTRODE ARRAYS FOR ARTIFICIAL RETINAL IMPLANT

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Diseases like Age-related Macular Degeneration or Retinitis Pigmentosa result in deterioration of photoreceptors in the retina, so eventually leading to blindness. And the degenerated retina can't be cured by conventional treatments. So artificial retina systems, which transfer external power and encoded image signals to internally implanted microelectrode arrays onto the retina and evoke artificial vision using electrical stimulation, have been studied to substitute the degenerated retina. In this paper microelectrode arrays have been developed for artificial retinal system. To reduce the damage during intraocular implantation, flexible polyimide is selected as the substrate material of microelectrode arrays. The transparent characteristics of polyimide makes the handling of arrays in the eye very difficult, so we outlined the arrays with metal pattern. Various shapes of microelectrode arrays are designed to minimize the tissue damage and take beiter contact to the retina. There are perforations in the microelectrode arrays for humor circulation. The arrays are fabricated to maintain planar shape, and have high elasticity to be tolerable to bending or twisting. Gold and polysilicon are used as the electrode materials. With the microelectrode arrays, we observed the biocompatibility by long term implantation in rabbits' eye and human retinal pigmentosa epithelium cell culturing on the arrays. For 60 days after implantation, there is no sign of inflammation or swelling at the interface. The cultured cell had the same behavior with control group for 20 days. Biocompatibility and biostability of developed microelectrode arrays have been proved. With this experiment and afterward research, the microelectrode arrays are expected to function as stimulating or recording arrays for artificial retina.

Key Words: Artificial retina, Microelectrode arrays, Bio-compatibility

POPULATION VECTOR ANALYSIS ON STIMULUS INPUT DEPENDING ON TIME IN RAT SI CORTEX

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Two principles of information encoding have been suggested to understand sensory processing in the nervous system. The first is a labeled line principle and the second is a population encoding principle. Recent studies favor population-encoding principle. In this study, we tried to analyze how stimulus location encoding among simultaneously recorded single neurons of the primary somatosensory (SI) cortex of rat is changing depending on the post-stimulus time in view of population encoding principle.

In an experiment, tactile stimulation (1 Hz) was applied either to the left 5th digit or to the left lateral palm respectively. In other experiment, both peripheral locations were simultaneously stimulated. To see how response population vectors are changing in time domain, we normalized each 18 dimensional vectors to unit size and plotted temporal vectorial distance variations compared with maximally active instance. The plotting showed response population vector is not statically or constantly encoded during active period. Its dynamic variation exhibited an oscillating feature with 5 ms period and initial overshoot. As time passes, the oscillating feature was somewhat modulated by activity dependent manner but its basic oscillating feature was maintained. When two different body parts were co-stimulated, response population vector showed non-linearity. That is, co-stimulation vector does not show simple linear addition of two different response vectors. These results suggested that the nature of stimulus encoding among ensembles of SI cortex neuron of the rat is not static, but non-linear during active response period.

Key Words: Encoding, Population, Vector, Somatosensory, Time