Coating for electrodes of IL Receptors for brain (Ramot)

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Technology

The present technology provides an electrode coated by a bioactive protein, designed for chronic implantation into the central nervous system (CNS; brain or spinal cord). The bioactive coating actively and significantly reduces the immune reaction to the chronically implanted electrode. Thus, it prolongs the beneficial effects of deep brain and spinal cord stimulation based therapies.

The Need

Implantation of electrodes for electrical deep brain stimulation (DBS) and spinal cord stimulation are widely used for treatment of brain malfunctions such as Parkinson's disease (PD), epilepsy, major depression, dystonia and essential tremor and for chronic pain. Reports of a reduction in the efficacy of DBS therapy are heavily linked with the brain's immune response to the chronically implanted electrodes. The immune reaction defines a time limit for the beneficial therapeutic effects of neuronal stimulation due to the formation of a scar tissue (glial scar) that encapsulates the chronic electrode. The current strategy to overcome this biocompatibility challenge is systemic application of immune suppressing drugs or using electrodes coated with soluble drugs. Yet, while the first strategy results in severe side effects the latter is time limited. Our active bio-coating offers two main tools for reducing the immune response; (a) the innate non-soluble coating protein, namely, interleukin 1 receptor antagonist (IL1ra) camouflages the electrode from the immune system and (b) the IL1ra actively and locally reduces the immune response, strongly limits the formation of scar tissue and actively prolongs the efficacy of electrical stimulation therapy.

Potential Application

Present bioactive coating can be used for prolonging the therapeutic efficacy of deep brain stimulation and chronic pain spinal cord stimulation. Thus it can be used in subjects with Parkinson's disease (PD), epilepsy, major depression, dystonia and essential tremor and for chronic pain.

Stage of Development

The bioactive coating was tested in an in-vivo rat model that were chronically implanted with silicon electrodes as it is a common material for chronic electrodes. With very little adaptation, the bioactive coating can be applied to a variety of materials including plastics, silicon-based materials, metals and polymers. In an in-vivo rat model, the IL-1ra coated electrodes initiated significantly less immune reaction i.e. glial scar when tested 1 and 4 weeks after implantation. Specifically, the bioactive electrode initiated ~50% and ~90% less immune response compared to the commonly used silicon electrodes, when examined 1 and 4 weeks after implantation, respectively. Importantly, the beneficial effect of the bioactive IL-1ra coated electrodes was demonstrated as it initiated ~60% less immune response compared to an electrode which was coated with a non-active protein (laminin).

Patents

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Supporting Publications

Taub, Aryeh H., et al. Bioactive anti-inflammatory coating for chronic neural electrodes. Journal of Biomedical Materials Research Part A 100.7 (2012): 1854-185

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