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Three-dimensional macroporous nanoelectronic networks as minimally invasive brain probes

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Abstract

Direct electrical recording and stimulation of neural activity using micro-fabricated silicon and metal micro-wire probes have contributed extensively to basic neuroscience and therapeutic applications; however, the dimensional and mechanical mismatch of these probes with the brain tissue limits their stability in chronic implants and decreases the neuron-device contact. Here, we demonstrate the realization of a three-dimensional macroporous nanoelectronic brain probe that combines ultra-flexibility and subcellular feature sizes to overcome these limitations. Built-in strains controlling the local geometry of the macroporous devices are designed to optimize the neuron/probe interface and to promote integration with the brain tissue while introducing minimal mechanical perturbation. The ultra-flexible probes were implanted frozen into rodent brains and used to record multiplexed local field potentials and single-unit action potentials from the somatosensory cortex. Significantly, histology analysis revealed filling-in of neural tissue through the macroporous network and attractive neuron-probe interactions, consistent with long-term biocompatibility of the device.

Comment in

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