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09:30

In–vivo cortical and hippocampal activity recordings by using high-resolution plastic electrode

arrays

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Resume : The development of plastic probes for neural recordings is current and promising subject in neuroscience research. In the case of implantable microelectrodes the rigid nature of the probe cannot compensate the brain movements and is thus not ideal for extended in-vivo recordings. Moreover, the week signals recorded from these probes caused by the mechanical tissue scar and biological incompatibility between the probe and the brain slow down the process of furthering understanding of the brain function. We developed the process to fabricate flexible microelectrodes arrays providing high-resolution neuronal activity recordings in cortical

and hippocampal areas of a rat brain. The fabrication flow allows building the probes base on polyimide and SU-8 flexible and plastic materials. The coating of recording sites with conducting polymers opens great opportunities to improve the electrical communication between the electrode and the brain. The first in-vivo implantation shows high-resolution LFP (local field potential) signal recordings and a small glial response from histological data. These results offer promising solutions to improve the interface between the brain and the probe.

9:45

Conducting Polymer Electrodes for human electrophysiological recordings

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Resume : Many challenges are presented by simultaneous recordings at multiple scales in humans. One concerns long-term EEG (Electroencephalography) measurement during SEEG (Stereoelectroencephalography). Today's electrodes require skin preparation and the use of conducting gels which are not ideal for long-term recordings. One solution consists of using conducting polymers to design a new type of dry electrode. We adapted small dry electrodes, already used for multisite recordings in the auditory cortex in animals and polysomnographic

recordings. We discuss the influence of conducting polymer on the quality of the recordings.

Conducting polymers are naturally compatible with flexible substrates, and are known to

decrease electrode impedance and improve the quality of recordings of neuronal activity. We

used commercially available doped polythiophenes, deposited from solution. We optimized film

morphology by varying the deposition conditions, in an effort to minimize the impedance and

maximize the signal to noise ratio of our recordings. We show that conducting polymers are

adapted to the irregular scalp surface and provide low skin-electrode interface impedance and facilitates recording at numerous locations. These electrodes fit with the context of long-term

EEG recording, as they avoid the variation of impedance with time associated with changes in

the conducting gel. The ease of attaching these electrodes to the skin makes the simultaneous

recording of EEG and SEEG possible.

12:00

Highly Conformable Conducting Polymer Electrodes for In Vivo Recordings

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Resume : Electronic devices that interface with living tissue have become a necessity in clinics to improve diagnosis and treatments. On a more fundamental level, most breakthroughs in our understanding of the basic mechanisms of information processing in the brain have been obtained by means of recordings from implantable electrodes. Given the high demand for the

development of biocompatible and conformable electrodes and given the advantages provided by conducting polymers for neuronal interfacing, it is essential to develop general procedures for integrating conducting polymers with flexible substrates. Here, we present a generic solution to this challenge and demonstrate highly conformable electrode arrays. A photolithographic process was used to integrate the conducting polymer poly(3,4-ethylenedioxythiophene):poly(styrene sulfonate) (PEDOT:PSS) with parylene C, yielding highly conformable electrode arrays. The array is only four micrometers thick, with the

Au interconnects and the PEDOT:PSS located at the neutral mechanical plane. We

demonstrate the use of these electrode arrays for in vivo electrocorticography (ECoG) in rats, in

which sharp-wave events mimicking epileptic spikes were successfully recorded. The arrays

had a hole in the middle (through the Parylene film), in order to allow the simultaneous insertion

of a deep brain probe. Despite their thinness, the electrode arrays had adequate mechanical

strength to be self-supporting and to be manipulated by a surgeon. We also show that the

arrays provide high spatial resolution and that PEDOT:PSS electrodes outperform Au ones during in vivo evaluation of devices of similar geometry. In addition to their application in ECoG, highly conformable electrode arrays can find a host of other applications in Neuroscience. They can be folded on themselves, creating arrays with electrodes on both sides. Such arrays provide a means of recording ECoG signals inside sulci in the human brain, which will further diagnostic capabilities. Moreover, with the aid of an appropriate insertion shuttle, they can be implanted deep in the brain, where, owing to their high mechanical flexibility, they might be less invasive than traditional electrode arrays made from hard materials.

12:15

In vivo use of OECT electrodes for neurological network recording

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Resume : The development of new type of probes is important to improve our understanding of

neuronal networks. Organic electrochemical transistor (OECT) provides a very sensitive way to

record ionic currents. The conventional neuronal probes, with multiple recording sites, allow the

recording of neuronal activities on freely moving animals. We developed new OECT probes, implantable or designed for surface electrocorticogram (ECoG) recordings (E-probe), in order to increase the quality of the recorded signal and to reduce the size and weight of the devices on the head of the animal (as the transistor amplified the gate current, a preamplifier will not be required). These new OECT microelectrodes were designed to be used in vivo in order to study the neuronal networks dynamics in physiological and pathological conditions. We performed in vivo recordings in normal and epileptic rats (GAERS) and we show that these new probes bearing high density classical and transistor sites are suited to record network dynamics in vivo.