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**2:30 PMBREAK**

**3:30 PM *SB05.10.04**
**Biohybrid Interfaces with Light-Sensitive Dynamic Polymers for Neuroelectronic Applications**FrancescaSantoro; Forschungszentrum Jülich/RWTH Aachen University, Germany

Bioelectronic platforms more and more aim to integrate into tissues and organs in a seamless way to monitor and eventually restore loss functionalities. This is particularly relevant for brain implants where the functional electrical connections can be restored by the use of functional electrodes to stimulate injured area due to pathologies such as neurodegenerative diseases. In this scenario, polymers have found a major use in the last decade to design and engineer organic biointerfaces[1] between electronics and brain cells also with their integration into soft flexible probes. However, existing platforms still lack: 1) 2.5-3D features to locally better anchor to the target area, 2) undergoing on demand mechanical plasticity which is greatly required because of micromovements and tissue reshaping over time and 3) materials which exhibit also electrical plasticity and not only conventional passive behavior to better enhance the ion-electronic transduction process which is at the core of the neuronal communication in the brain. Here, we will present how conjugated polymers can be engineered with azopolymers (opto-sensitive polymers which switch from cis to trans conformation upon certain light exposure) to feature diverse optoelectro-mechanical properties from nano to macroscale lever in organic bioelectronic platforms. In particular, we will discuss how azo-based materials can be patterned into 2.5-3D designs to locally couple to cells and thus dynamically tune the cell electrode interface over time[2]. Furthermore, these films can be further engineered with PEDOT:PSS to create dynamic organic electrochemical transistors (OECT, Figure 1) which also exhibit opto-electronic short and long term plasticity, enabling the use of such platforms as neurohybrid[3] devices.
This new class of on demand organic opto-electronic devices[4] paves the new for bioelectronic implantable platforms to be more biomimetic as they can adapt to the 3D environment of the neuronal tissue and its continuous reshaping, also featuring neuromorphic electrical behavior.

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**4:00 PM SB05.10.05**
**Hair-Compatible Sponge Electrodes Integrated on VR Headset for Electroencephalography**HongbianLi, HyonyoungShin, MinsuZhang, Jose del R.Millán and NanshuLu; The University of Texas at Austin, United States

Electroencephalography (EEG) combined with virtual reality (VR) represents a promising method for the measurement of brain activity in an immersive and interactive environment, which can provide insights into cognitive and neural processes. However, current VR-EEG headsets mainly rely on rigid comb electrodes, which are uncomfortable after prolonged wear. To address this limitation, we created soft, porous, and hair-compatible sponge electrodes based on conductive poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS)/melamine (PMA), and integrated them onto a VR headset through a customized flexible circuit for multichannel EEG during VR task performing. Our PMA sponge electrodes can deform to make contact with the scalp skin through hairs under the pressure naturally applied by the strap of the VR headset. As a result, our VR-EEG headset is capable of recording alpha rhythms during eye-closure at both hairless and hairy sites. Furthermore, we developed a VR task to evoke the contingent negative variation (CNV) potential and achieved a classification accuracy of 0.66±0.07. Our sponge-electrode-integrated VR headset is user-friendly and easy to set up, marking a step toward future reliable, comfortable, and reusable VR-EEG technology.

**Keywords:** PEDOT:PSS, soft electrode, electroencephalography, virtual reality

Reference
Li, H. B.; Shin, H.; Zhang, M. S.; Lu, N. S.* et al. Hair-Compatible Sponge Electrodes Integrated on VR Headset for Electroencephalography. Soft Science, 2023, in press.

E-mail: hongbian.li@austin.utexas.edu

**4:15 PM SB05.10.06**
**A Flexible and Switch-Matrix-Addressable Active Electrode Array Based on Complementary Organic Electrochemical Transistor and p-n Diode Technology**IlkeUguz[1], DavidOhayon[2], SophieGriggs[3], SahikaInal[2] and KennethL. Shepard[1]; [1]Columbia University, United States; [2]King Abdullah University of Science and Technology, Saudi Arabia; [3]University of Oxford, United Kingdom

Due to their effective ionic-to-electronic signal conversion and mechanical flexibility, organic neural implants hold considerable promise for biocompatible neural interfaces. Current approaches are, however, primarily limited to passive electrodes due to a lack of circuit components to realize complex active circuits at the front-end. Here, we introduce a p-n organic electrochemical diode (OED) using complementary p- and n-type conducting polymer films embedded in a 15-µm -diameter vertical stack. Leveraging the efficient motion of encapsulated cations inside this polymer stack and the opposite doping mechanisms of the constituent polymers, we demonstrate high current rectification ratios and fast switching speeds. We integrate p-n OEDs with organic electrochemical transistors (OECT) in the front-end pixel of a recording array. This configuration facilitates the access of OECT output currents within a large network operating in the same electrolyte, while minimizing crosstalk and interference from neighboring elements. We further demonstrate it to generate time-division-multiplexed amplifier arrays. When fabricated in a shank format, this technology enables the multiplexing of amplified local field potentials directly in the active recording pixel in a minimally invasive form factor.

**4:30 PM SB05.10.07**
**Investigating the Effect of Photopharmacological Interventions on Cortical Seizures using Organic Perforated Multielectrode Arrays**SofiaDrakopoulou, LintaSohail, JeroenSpanoghe, DinaK.C., RobrechtRaedt and GeorgiosD. Spyropoulos; Gent University, Belgium

Epilepsy is a chronic neurological disorder characterized by recurrent seizures, affecting millions of people worldwide. Current treatment methods have limitations such as side effects and incomplete seizure control. One potential approach to address these challenges is by targeting the adenosine type 1 receptor, which is abundantly present in the body, for epilepsy suppression. However, it is important to note that this approach may introduce multiple undesired side effects such as dizziness, sleep disturbances, mood, cognitive, memory changes etc.
Optopharmacology is an emerging approach for the treatment of focal epileptic seizures by activating and deactivating photoswitchable/photocaged molecules with light. It is a particularly interesting treatment solution which could result in powerful suppression of focal seizures with a limited number of side effects.
In this work, we study the neural dynamics of epileptic networks (in rodent model) and the effect of timely photo-release of a caged adenosine type 1 receptor agonist (caged CPA; N6-cyclopentyladenosine) hereon. To achieve that, we had to develop: i) animal protocols with evoked epileptic seizures, ii) illumination protocols proper for photorelease of the novel caged CPA molecule, iii) efficient microelectrode arrays, to trace the corresponding electrophysiology, that can simultaneously offer large spatial epidural coverage and high signal to noise ratio without sacrificing resolution or hindering illumination and drug appliance. In more detail, we performed craniotomies on several subjects to place semitransparent microelectrode array based on organic electronics on dura and trace electrophysiology. To provoke focal random epileptic seizures 4 - Aminopyridine (4-AP) was microinjected in different areas of the rat brain through specifically designed perforation paths. Upon microinjection of caged CPA epileptic activity continued but when the brain was exposed to pulses of 405nm light for uncaging of cCPA, local epileptic activity was strongly attenuated.
The results of this study provide a better understanding of propagation of 4AP induced seizures and confinement dynamics upon spatially resolved optopharmacological interventions. These findings are significant because they will positively impact the development of optopharmacological molecules and protocols, microelectrode arrays and therapeutic systems.

**4:45 PM SB05.10.08**
**Surface Modification with Biocompatible Polymer Conductors for Stable and Compliant Electrode Interfaces for Communicating with Neurons**RachelBlau[1], AbdulhameedAbdal[2], WadeShipley[1], YiQie[1], AllisonLim[1], SamanthaRussman[2], AlexanderX. Chen[1], GuillermoEsparza[1], ShadiDayeh[2] and DarrenJ. Lipomi[1]; [1]University of California; San Diego, United States; [2]University of California San Diego, United States

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