STRETCHABLE ORGANIC ELECTROCHEMICAL TRANSISTORS

Shiming Zhang*

Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR, China

**Corresponding author: szhang@eee.hku.hk*

Sehr geehrte Damen und Herren,

hiermit laden wir Sie/euch herzlich zum **Vortrag** von Herrn Zhang am

Dienstag den 6. Juni 2023 um 10:00 s.t. im NW1 Raum W1180

ein. Wir freuen uns auf Ihren/euren Besuch.

ABSTRACT

Organic bioelectronics have gone wild in the past decades. As the flagship device, organic electrochemical transistors (OECTs) provide a new choice for next-generation bioelectronic devices[1]. For one thing, inherent advantages of organic electronics get retained in OECT, such as the diversity of material selection and tunability of structure design. For another, the nature of volumetric capacitance and high transconductance lead to exceptional signal amplification.

However, despite past trials to promote OECT applications in the bioelectronic field, there is still an important issue, the limited softness and stretchability[2], which causes a mechanical mismatch with soft and elastic biological interfaces, triggering device failures under repeated deformation like bending, twisting, or beating.

As an essential category of organic electronics, OECT has been studied for decades. However, research on stretchable OECT is still in its infancy. Previous research is limited, and there are no satisfactory devices currently for practical usage. The key challenge is how to maintain the electrical performance of OECTs when improving their mechanical properties, as strain tends to influence two sides adversely. To achieve trade-offs, it's imperative to develop new stretchable material systems (semiconductors, electrolytes, elastomers, insulators) and processing protocols allowing scalable and reliable device fabrications.

In this talk, I will backtrack the conceptualization of stretchable OECTs[2]. Then, I will show the material development of stretchable interconnects[3], stretchable conducting polymers[3, 4], and stretchable hydrogels[5] for stretchable OECTs. Finally, I envision how stretchable OECTs can enrich the toolbox of current bioelectronic technologies to promote translational biomedical innovations for soft wearables[6-8], brain-inspired computing, human-machine interfaces, etc.

References

1. Zhang, S. M.; Cicoira, F., Flexible self-powered biosensors. *Nature* **2018,** *561* (7724), 466-467.
2. Zhang, S.; Hubis, E.; Tomasello, G.; Soliveri, G.; Kumar, P.; Cicoira, F., Patterning of Stretchable Organic Electrochemical Transistors. *Chemistry of Materials* **2017,** *29* (7), 3126-3132.
3. Zhang, S.; Li, Y.; Tomasello, G.; Anthonisen, M.; Li, X.; Mazzeo, M.; Genco, A.; Grutter, P.; Cicoira, F., Tuning the Electromechanical Properties of PEDOT:PSS Films for Stretchable Transistors And Pressure Sensors. *Advanced Electronic Materials* **2019,** *5* (6), 1900191.
4. Zhang, S.; Cicoira, F., Water-Enabled Healing of Conducting Polymer Films. *Advanced Materials* **2017,** *29* (40), 1703098.
5. Zhang, S.; Chen, Y.; Liu, H.; Wang, Z.; Ling, H.; Wang, C.; Ni, J.; Çelebi-Saltik, B.; Wang, X.; Meng, X.; Kim, H.-J.; Baidya, A.; Ahadian, S.; Ashammakhi, N.; Dokmeci, M. R.; Travas-Sejdic, J.; Khademhosseini, A., Room-Temperature-Formed PEDOT:PSS Hydrogels Enable Injectable, Soft, and Healable Organic Bioelectronics. *Advanced Materials* **2020,** *32* (1), 1904752.
6. Zhang, S.; Ling, H.; Chen, Y.; Cui, Q.; Ni, J.; Wang, X.; Hartel, M. C.; Meng, X.; Lee, K.; Lee, J.; Sun, W.; Lin, H.; Emaminejad, S.; Ahadian, S.; Ashammakhi, N.; Dokmeci, M. R.; Khademhosseini, A., Hydrogel-Enabled Transfer-Printing of Conducting Polymer Films for Soft Organic Bioelectronics. *Advanced Functional Materials* **2020,** *30* (6), 1906016.
7. Tian, X.; Liu, D.; Bai, J.; Chan, K. S.; Ip, L. C.; Chan, P. K.; Zhang, S., Pushing OECTs toward Wearable: Development of a Miniaturized Analytical Control Unit for Wireless Device Characterization. *Analytical Chemistry* **2022,** *94* (16), 6156-6162.
8. Liu, D.; Tian, X.; Bai, J.; Wang, Y.; Cheng, Y.; Ning, W.; Chan, P. K. L.; Wu, K.; Sun, J.; Zhang, S., Intrinsically Stretchable Organic Electrochemical Transistors with Rigid-Device-Benchmarkable Performance. *Advanced Science* **2022,** *9* (29), 2203418.

Bio: Shiming Zhang is currently an Assistant Professor at the University of Hong Kong (HKU), leading the wearable, intelligent, and soft electronics (WISE) research group. Before joining HKU, he spent three years at The University of California, Los Angeles (UCLA) as a postdoctoral scholar, leading the medical wearables research direction in the Center of Minimally Invasive Therapeutics at UCLA. He obtained his Ph.D. (Best Thesis Awardee) from École Polytechnique, Université de Montréal, Canada, and BS and MS (Highest Honor) from Jilin University, China. He is known for his contributions in developing the first stretchable organic electrochemical transistors (OECTs). His lab developed the "PERfECT" readout system, which is a small (coin-sized), lightweight (0.4 grams), and smartwatch-integratable analytical control unit that can be for wearable characterization of OECTs and devices of similar kinds.