Advances in bioelectronics based on vertical organic electrochemical transistors

Wei Huang
University of Electronic Science and Technology of China
whuang@uestc.edu.cn

Organic electrochemical transistors (OECTs) have great potential for bioelectronics, wearable electronics, and artificial neuromorphic electronics, due to their low driving voltages (< 1 V), low power consumption (< μW), high transconductances (> mS), bio-compatibility, and facile integration in mechanically flexible and stretchable device platforms. A novel device structure with a sub-micrometer channel length can be realized by simply utilizing vertically stacked source/drain electrodes, leading to the ultra-high transconductance of more than 0.4 S, along with more than stable 50,000 cycles and fast switching of less than 1 ms. Such high performance yielded with the vertical structure can effectively shrink the overall package size of the sensors and lead to a highly integrated multiple-functionality sensing array. These results open many possibilities for realistic systems in applications such as wearables and implantable devices, where small effective footprints, high transconductance, and low driving voltages are essential. It also opens opportunities for fundamental studies of the redox chemistry and physics of organic semiconductors in nanoscopically confined spaces without requiring macroscopic contact with the electrolyte.