Water-Stable Organic Field-Effect Transistor-Based Sensors Using DBTTT-Derivatives as Semiconductor Thin Film

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Organic field-effect transistor (OFET) platforms have many advantages in application as sensors due to low cost, biocompatibility, flexibility, and especially high sensitivity. In OFET-based sensors, charge carrier density can be changed by binding events with analytes, which can be amplified by modulating the gate voltage. Despite these advantages, OFET-based sensors still face many challenges in that they are unstable in an aqueous system. Here, we developed a water-stable semiconductor material through rational molecular design. A dibenzothiopheno[6,5-b:6′,5′-f]thieno[3,2-b]thiophene (DBTTT)-derivative was used as the semiconductor material due to its high mobility and superior water stable operation. In this system, we could detect water-based analytes such as sweat. Sweat sensor has been extensively investigated in recent years because it can detect the sweat components containing health information while being attached to human body. We selected one target component, which is a biomarker of stress-related health conditions in sweat. Our approach offers a viable way for the fabrication of the high-performance OFET-based sensors compared to classical sensor devices.