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Field Effect Transistor of Organic Single Crystal by Using Solid/Liquid Interfaces

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Organic field effect transistor (OFET) has been tentatively studied due to its excellent properties, such as flexibility and functionality. Specifically, the highly precise detection of chemical reactions at solid/liquid interfaces is a promising application of (electrochemical) OFET.

Rubrene single crystals formed by physical vapor transport or recrystallization from solid/liquid interfaces are used in our study as a channel material [1]. The surface of crystal is almost perfect because it consists of molecular steps and atomically flat terraces whose sizes are several micrometers. Aqueous electrolytes, as a gate electrode, are in contact with the crystal to use the electrolyte as a gate. To get a good contact between the crystal and the electrolyte, the crystal is attached to the glass capillary above which the electrolyte is filled up. Leak currents, which are often observed in other electrochemical FET, can be thus inhibited by this fabrication method. The electrical double layer between the electrolyte and the crystal can be used as a gate capacitor. Source and drain electrodes are fabricated at the back side of the crystal.

The carrier (hole) injection behavior is in detail studied by electrochemical methods, and it is found that there is an threshold of the redox potential (Fermi level in solution) of the electrolyte to inject the carriers. Further, the electrochemical FET using the interface between the electrolyte and the rubrene single crystal exhibit a good current-voltage (I_D-V_D, I_D-V_G) characteristics, compared to previous studies. The detail of this study shall be presented in the meeting.

References

[1] K. Itaya et al., Langmuir 23 (2007) 12788.