Electronic Supplementary Material (ESI) for ChemComm.

Supplementary Information

An extended-gate type organic field effect transistor functionalised by phenylboronic acid for saccharide detection in water

Tsuyoshi Minami,* Tsukuru Minamiki, Yuki Hashima, Daisuke Yokoyama, Tomohito Sekine, Kenjiro Fukuda, Daisuke Kumaki, and Shizuo Tokito

---

Research Center for Organic Electronics (ROEL), Graduate School of Science and Engineering, Yamagata University, 4-3-16 Jonan, Yonezawa, Yamagata 992-8510, Japan. E-mail: tminami@yz.yamagata-u.ac.jp

Contents

General

Reagents and solvents used for this study were commercially available and used as supplied. 4-Mercaptophenylboronic acid and Octadecylphosphonic acid were purchased from Sigma–Aldrich Inc. Cytop ® (CTL-809M), PEN film, poly(2,5-bis(3-hexadecylthiophene-2-yl)thieno[3,2-*b*]thiophene, gold, aluminum, FC-43 fluorinert, Teflon® AF1600, HEPES, and methanol were purchased from Asahi Glass Co. Ltd., Teijin DuPont Films, Merck KGaA, Tanaka Kikinzoku Kogyo, Furuuchi Chemical Co., 3M Co., Dupont, Dojindo Laboratories, and Kanto Kagaku, respectively. 1,2-Dichlorobenzene, glucose, fructose, sodium dihydrogenphosphate dihydrate, and disodium hydrogenphoshate were purchased from Wako. Mannose, galactose and benzenthiol were purchased from TCI. The phosphate buffer solutions were prepared using Milli-Q water (18 MΩ cm at 25 ºC).

Metal electrodes were deposited by using a vacuum evaporator equipment from Cryovac, Co. An oxygen-plasma treatment was performed on a PC-300 plasma cleaners from Samco, Inc. UV ozone treatment was by a UV253H UV ozone cleaner from Filgen, Inc. The bank layers were prepared using an IMAGEMASTER 350 dispenser equipment from Musashi Engineering, Inc. Photoelectron spectroscopy measurements in air were performed using an AC-3 from Riken Keiki, Co. Wettability measurements were performed on a Theta T200 contact angle goniometer from Biolin Scientific, Co. X-ray photoelectron spectroscopy was measured by an ULVAC PHI-5600 spectrometer from ULVAC-PHI, Inc. Variable angle spectroscopic ellipsometry measurements at seven incident angles from 45 ° to 75 ° in steps of 5 ° were performed on a M-2000U from J. A. Woollam Co., Inc. The pH values of solutions were measured by a D-51 pH

meter (Horiba, Ltd.). The Ag/AgCl electrode as the reference electrode was purchased from BAS, Inc. The electrical characteristics of the all OFET devices were measured using a Keithley 2636B source meter.

X-ray Photoelectron Spectroscopy

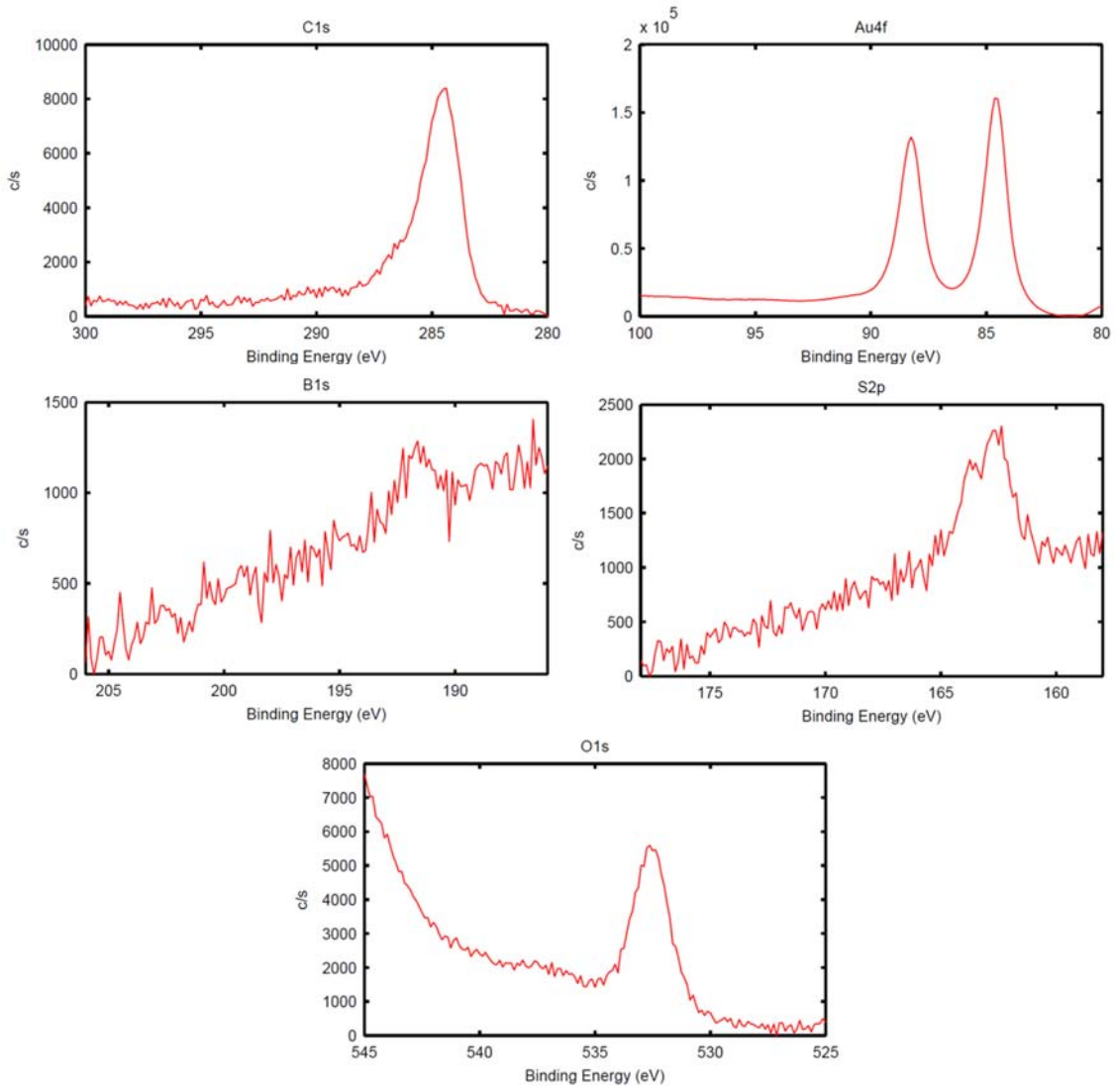

Fig. S1. X-ray photoelectron spectroscopy measurements on the Au electrodes after phenylboronic acid-SAM treatment.

Water contact angle measurements

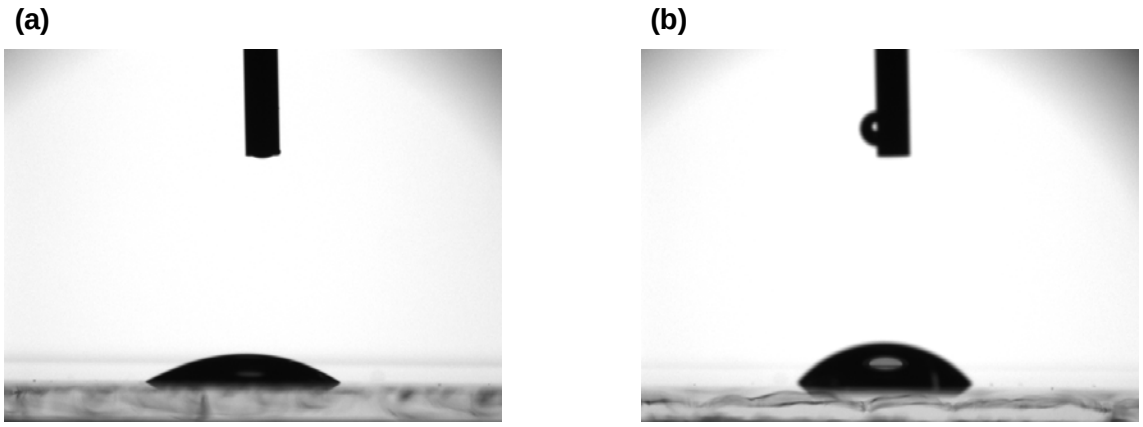

Fig. S2. Water contact angle measurements on the Au electrodes before and after phenylboronic acid-SAM treatment. (a) Untreated Au, (b) phenylboronic acid-SAM treated Au.

Electric characteristics of the OFET

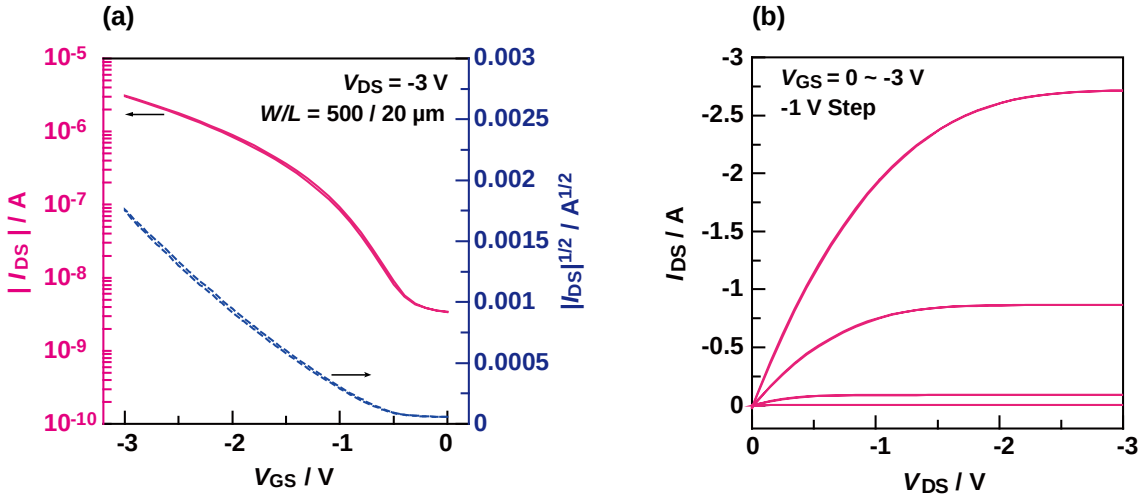

Fig. S3. The electric characteristics of the organic FET under 3 V. (a) Transfer characteristics of the fabricated OFET device. (b) Output characteristics of the same device.

Saccharide titrations

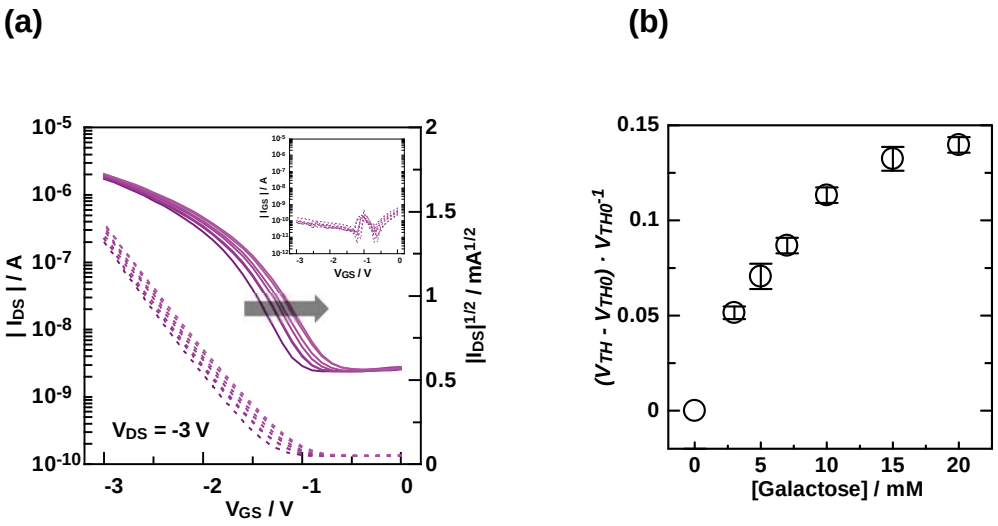

Fig. S4. (a) Transfer characteristics (I_{DS}-V_{GS}) of the OFET device upon titration with galactose in a phosphate buffer solution (100 mM) at pH 7.4 at room temperature. (b) Changes in threshold voltage for the OFET devices by galactose at various concentrations in a phosphate buffer solution (100 mM) with pH 7.4 at room temperature. [Galactose] = 0-20 mM. For each analyte, five repetitions were measured.

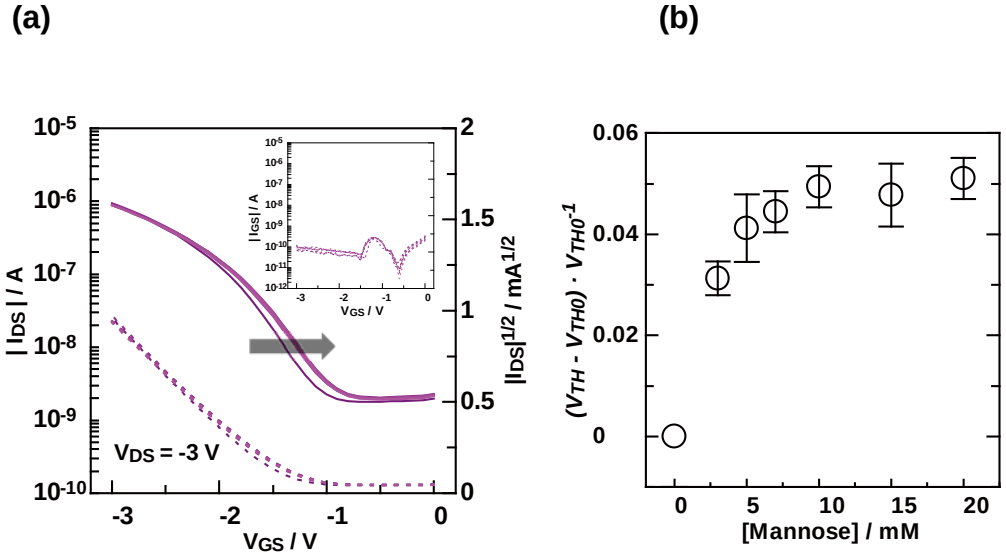

Fig. S5. (a) Transfer characteristics (I_{DS}-V_{GS}) of the OFET device upon titration with mannose in a phosphate buffer solution (100 mM) at pH 7.4 at room temperature. (b)

Changes in threshold voltage for the OFET devices by mannose at various concentrations in a phosphate buffer solution (100 mM) with pH 7.4 at room temperature. [Mannose] = 0-20 mM. For each analyte, five repetitions were measured.

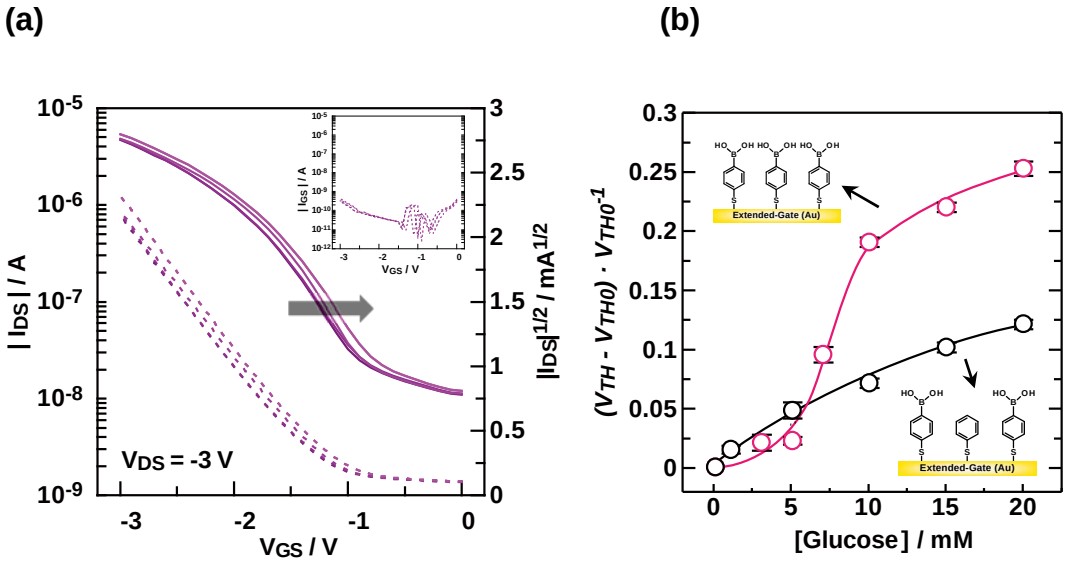

Fig. S6. (a) Transfer characteristics (I_{DS}-V_{GS}) of the fabricated OFET device with a SAM of a 4-mercaptophenylboronic acid and benzenthiol mixture on the extended Au electrode upon titration with glucose in a phosphate buffer solution (100 mM) at pH 7.4 at room temperature. (b) Changes in threshold voltage for the OFET devices by glucose at various concentrations in a phosphate buffer solution (100 mM) with pH 7.4 at room temperature. Red circle: 4-mercaptophenylboronic acid-functionalized Au electrode. Black circle: a 4-mercaptophenylboronic acid and benzenthiol mixture-functionalized Au electrode. The molar ratio of 4-mercaptophenylboronic acid and benzenthiol is 1:1. [Glucose] = 0-20 mM. For each analyte, five repetitions were measured.