

## Sampling time and pH-dependences of SiNW ISFET-based biosensors

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Si nanowire ion-sensitive field effect transistor (SiNW ISFET) is a promising solution for real-time, label-free, and low cost biosensor. However, the movement of ions in electrolyte causes the delay in transferring the potential of liquid gate voltage ( $V_{LG}$ ) into the functionalized surface of SiNW when  $V_{LG}$  is swept [1]. Therefore, the real-time output current of ISFET varies depending on a sampling time of readout circuit and the pH concentration as well although  $V_{LG}$  and  $V_{DS}$  (drain-to-source voltage) are fixed to specific values. It should be considered in establishing ISFET-based biosensor circuit and systems. In this work, the output current of top-down processed SiNW ISFET-based pH sensor [Fig. 1(a)] is investigated with varying the sampling time and pH value of electrolyte.

The sampling time used was controlled by a hold time ( $T_H$ ) and delay time ( $T_D$ ) with Agilent 4156C semiconductor parameter analyzer when  $V_{LG}$  is swept under a fixed  $V_{DS}$  [Fig. 1(b)]. The difference of ISFET current, i.e., denoted by  $\Delta I$ , depending on varying  $T_H$  and  $T_D$  is observed to increase with the increase of pH [Fig. 1(c)]. The difference of liquid gate current, i.e., denoted by  $\Delta I_{LG}$ , depending on varying  $T_H$  and  $T_D$  is also characterized [Fig. 1(d)]. Finally, the hysteresis as well as  $\Delta I$  and  $\Delta I_{LG}$  will be analyzed as the function of parameters, such as pH,  $T_H$ , and  $T_D$ , and related physical/chemical properties will be also discussed in detail. Our result is potentially useful in improving a signal-to-noise ratio of the biosensor readout circuit and system.

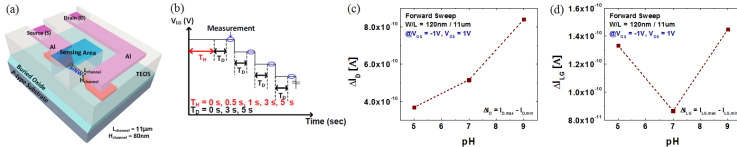


Fig. 1. (a) SiNW ISFET. (b) Used condition of sampling time. The pH-dependences of (c)  $\Delta I$  and (d)  $\Delta I_{LG}$ .

**Reference:** [1] Jungmok Kim, Hyoun Mo Choi, Hyun-Sun Mo, Jung Han Lee, Dong Myong Kim, Sung-Jin Choi, Byung-Gook Park, Dae Hwan Kim, and Jisun Park, *MicroTAS*, T.449g, 1616 (2015).

**Acknowledgment:** This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Ministry of Science, ICT and Future Planning (Grant No. 2013R1A1A2065339), in part by BK+ with the Educational Research Team for Creative Engineers on Material-Device-Circuit Co-Design (Grant No. 22A2013000042), and in part by IC Design Education Center (IDEC).