# アプタセンサのためのペプチド機能化単層カーボンナノチューブ FET の研究
# Study on peptide-functionalized single–walled carbon nanotube field effect transistor for aptasensor

○Nguyen Thanh Tung[1], Phan Trong Tue[1], Truong Thi Ngoc Lien[2], Yasuhide Ohno[3], Kenzo Maehashi[4], Kazuhiko Matsumoto[5], Manish Biyani[1], Yuzuru Takamura[1] (1. JAIST, 2. HUST, 3.Tokushima Univ., 4. Tokyo Univ. Agr. Tech., 5. Osaka Univ. ISIR) Email: s1430030@jaist.ac.jp

**1. INTRODUCTION** Single-walled carbon nanotube field effect transistors (SWCNT FETs) have drawn much attention for biosensing application thanking to their quasi-one-dimensional SWCNT channel which is very small compared to the biomolecule dimension. However, short Debye-screening is a very severe drawback of SWCNT FET, which makes probe molecules that must be shorter than the Debye length. This issue could be resolved by using small receptor like DNA aptamers [1, 2]. In contrast with DNA aptamers that bind to complementary targets using entire sequence, peptide aptamers are smaller and only bind to their targets with single variable loop region. These distinct characteristics lead to reduction of the flexibility of peptide aptamers, and thus improving effectiveness. Accordingly, peptide aptamers appear as a strong bioreceptor candidate. In this work, we focused on studying peptide modification on SWCNT FET for biomolecule analysis.

**2. EXPERIMENTAL** SWCNTs were grown directly on $SiO_2$ (100 nm)/Si substrate at ethanol pressure of 1200 Pa, temperature of 850ºC for 30 min by using ethanol vapor deposition (CVD) method. Cobalt and ethanol solution were used as the catalyst and carbon feedstock, respectively. Then Ti/Au (2 nm/45 nm) source and drain electrode pads were formed to complete SWCNT FET. After that peptide aptamer that contains biotin were immobilized onto SWCNT channel via 1-pyrenebutanoic acid succinimidyl ester linker. Next, streptavidin as the target molecule with various concentrations (1µM to 2mM) was added for real-time detection. Figure 1 shows the schematic measurement setup with constant liquid-gated and drain voltages of 0 V and 200 mV, respectively.

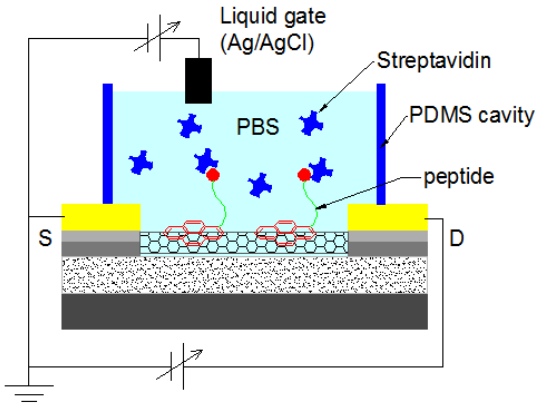


Figure 1: Schematic circuit of experimental setup

**3. RESULTS and DISCUSSION** Figure 2 shows the real-time detection of streptavidin using fabricated SWCNT FET biosensors. The drain current decreased with increases of streptavidin concentration. This indicates that partial positive charges from streptavidin were detected by the fabricated SWCNT FET. The initial result showed that peptide can be immobilized actively on SWCNT FET, and functionalizes detection of biomolecule by FET inside sensitive region of Debye length.

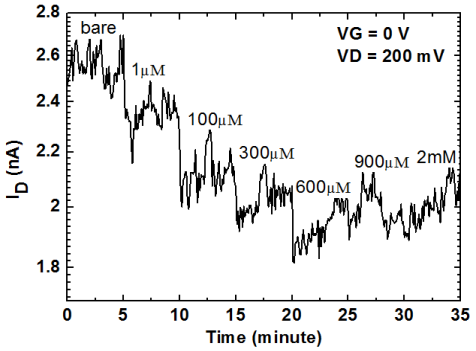


Figure 2: Time dependence of drain current after introduction of various streptavidin concentrations

**References**

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[2] Hye-Mi So et al., J. Am. Chem. Soc., 2005, 127, 11906 – 11907