## Supporting Information

# Aptamer-Engineered Extended-Gate Field Effect Transistor Device for Point-of-Care Therapeutic Drug Monitoring

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**Materials.**

All oligonucleotides were purchased from Sangon Biotech Co. Ltd (Shanghai, China). MTX, folic acid, and vancomycin were purchased from Sigma-Aldrich (Shanghai, China). (R)-omeprazole was purchased from J&K chemical Co. Ltd (Shanghai, China). Glucose was purchased from Rich Joint Co. Ltd (Shanghai, China). PBS and $MgCl_2$ were purchased from Thermo Fisher (Shanghai, China). FBS was purchased from Gibco (Shanghai, China).

**Modification of aptamers HMX-32**

The electrode arrays were ultrasonically washed in distilled water and dried in nitrogen atmosphere. Thiol-modified aptamers HMX-32 were incubated on the gold electrode surface for 24 h to immobilized on the gold gate with thiol-gold bonds. The gold electrodes were then thoroughly rinsed with water, and backfilled with 1mM MCH for 1h. Extra aptamers were removed with distilled water. MCH was incubated on the gold gate to remove the non-specifically absorbed aptamer HMX-32 and to block the remaining gold surface area. Finally, the electrode arrays were thoroughly rinsed with ethanol and water.

**MTX detection in PBS and 10%FBS**

Methotrexate was dissolved in 0.01M NaOH solution，and then diluted to 0.01 μM，0.1 μM，1 μM，10 μM，20 μM with 0.05*PBS (10%FBS) . Gold electrode surfaces were modified Aptamer HMX-32 and blocked MCH using previous optimization conditions. The temperature was maintained at 25℃ throughout the detection. 30μL of sample was uniformly covered on the surface of the reference electrode and the gold electrode during detection. Measure the output curve of 0.05*PBS (10%FBS) without the object and the current was regarded as I0 when VDS=2V and VGS=2V. Measure the output curve of 0.05*PBS (10%FBS) with varying concentrations of MTX after ten minutes of reaction and the currents were regarded as I. The change of current ($\Delta I_{DS}$) was calculated as $\Delta I_{DS} = I - I_0$, and the relative current variation was $\Delta I_{DS}/I_0$.

**Other molecules and mixture detection.**

Folic acid, vancomycin, penicillin, BSA and Glucose were diluted to 1μM with 0.05*PBS. Measure the output currents and calculate the relative current variations. Prepare the mixture solution of 100nM MTX and 1μM above substances respectively, measure the output curves in the same way and calculate the relative current variation. The temperature was maintained at 25℃ throughout the detection.

**MTX detection in serum of mice**

Three SD male mice weighing about 200 grams, fasted for solids and liquids for one night. Collect the whole blood from orbit of three mice and obtain the serum separated by freezing centrifugation. The solution of 10% mouse serum containing 0.01 μM，0.1 μM，1 μM，10 μM，20 μM MTX was prepared. Measure the output curve of above solution and calculate the relative current variations. These mice fasting for solids and liquids for one night were injected intraperitoneally 1ml suspension of MTX diluted with normal saline at a dose of 2.5mg/kg. The whole blood of three mice were collected from orbit at 6,12,24 hours after the injection and separated by freezing centrifugation to obtain serum. The output curves of diluted serum were measured with the same way.

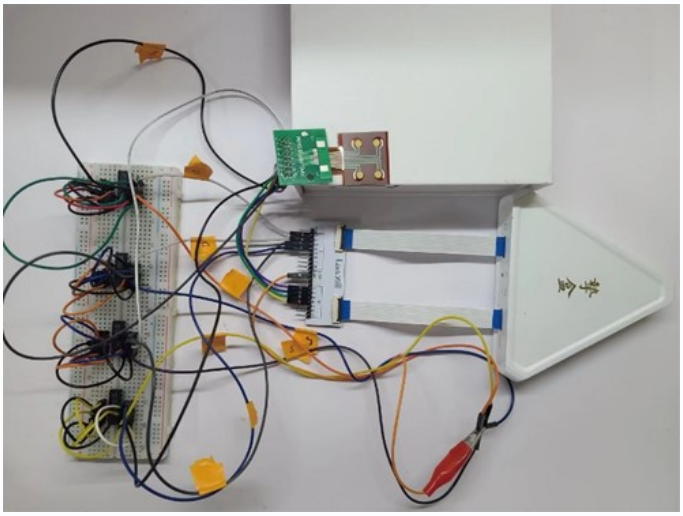

**Fig. S1.** Practical detection set-up diagram.

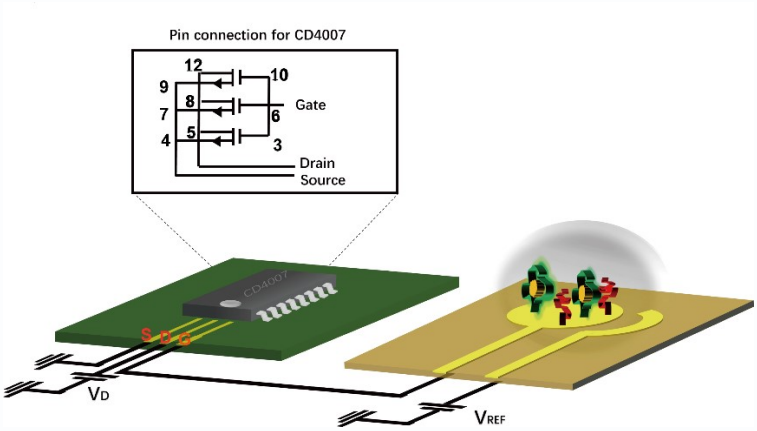


**Fig. S2.** Connection schematic diagram of EG-FET.

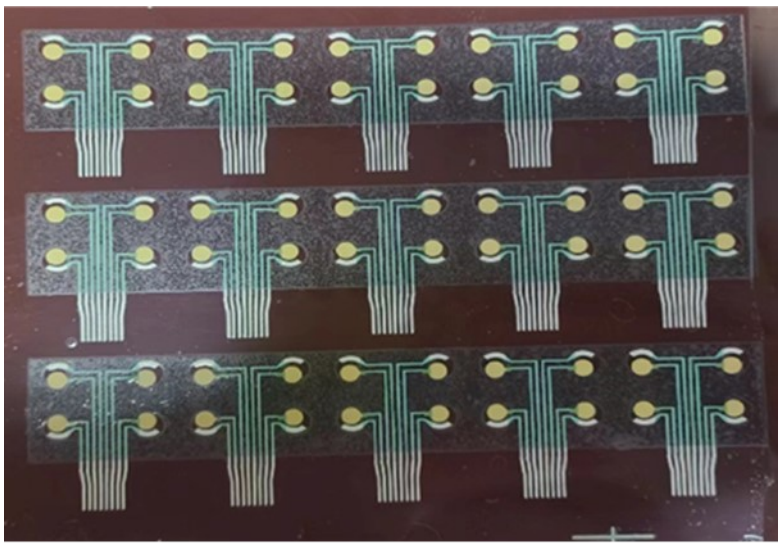

**Fig. S3.** The actual electrode arrays.

**Table S1.** Comparison of various detection methods

| **Detection method** | **Detection environment** | **Used material** | **Detection range** | **LOD** |
|---|---|---|---|---|
| Fluorescence | PBS | $MoS_2$QDs | 0.05-1μM | 42nM |
| Fluorescence | PBS | CQDs | 1-300μM | 0.33μM |
| Fluorescence | PBS<br>50%FBS | Aptamer | 0.1-2μM<br>0.5-10μM | 0.03μM<br>0.18μM |
| EIS | PBS | Antibody | $3*10^{-12}$-$3*10^{-4}$ M | 7pM |
| Electrochemical method | PBS | GCE modified with $Fe_3O_4$@$NH_2$-MCM-41 and CNOs | 10nM-50μM | 3nM |
| Electrochemical method | PBS | SPGE modified with Fe3O4/ppy/Pd | 0.03-100μM | 7nM |
| UHPLC-MS/MS | Human Urine | | 2.5-50ng/L | 2.5ng/L |
| HPLC-MS/MS | Human Erythrocytes | | 0.5-100nM | 0.5nM |
| EG-FET | PBS<br>10%FBS<br>10% mice serum | Aptamer | 10nM-10μM<br>10nM-10μM<br>10nM-10μM | 10 nM<br>10 nM<br>10 nM |

**References**


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