Supporting Information For

FEN 1-assisted swing arm DNA walker for electrochemical detection of ctDNA by target recycling cascade amplification

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Table S1 The sequences of these oligonucleotides in this work

DNA	Sequence	
ctDNA	5'-CTACGCCATCAGCTCCA-3'	(KARS G12D Mutation)
normal DNA (Nor)	5'-CTACGCCACCAGCTCCA-3'	(KARS G12D Normal)
one base-mismatched DNA (M-1)	5'-CTATGCCACCAGCTCCA-3'	
one base-mismatched DNA (M-2)	5'-CTACGCCACGAGCTCCA-3'	
one base-mismatched DNA (M-3)	5'-CTACGCCACCAGCTCTA-3'	
Hairpin DNA (HP) [a]	5'-**ATTACAGCTCCA***TTAGTCCGTCGTTGGAGCTGATGG*CGTAG-3'	
Hairpin DNA (HP-1)	5'-ATTACAGCTCCCTTAGTCCGTCGTTGGAGCTGATGGCGTAG-3'	
Capture DNA (CP) [a]	5'-SH-C_6-$(T)_n$*CCATCAGCTCCAACGACGGACTAAC*-3'	
MB-DNA (MB)[a]	5'-MB-CCGGGAGCTCCATCTGT**TGGAGCTGTAAT**-C_6-SH-3'	

[a] The bold parts of HP and MB represented the binding regions, similar like the italics parts of HP and CP.

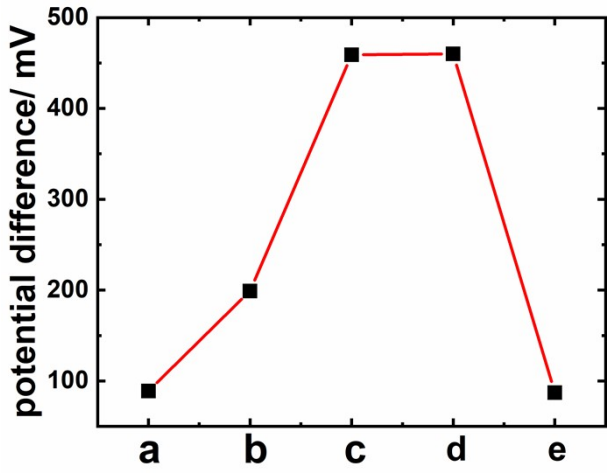

Fig. S1 the peak-to-peak potential difference of modified electrodes in Figure 1A. (a) bare Au electrode, (b) CP+MB/Au, (c) MCH/CP+MB/Au, 2 μM HP and 1 ng/μL FEN 1 in the absence (d) and presence (e) of 10 pM ctDNA at 47°C for 2h

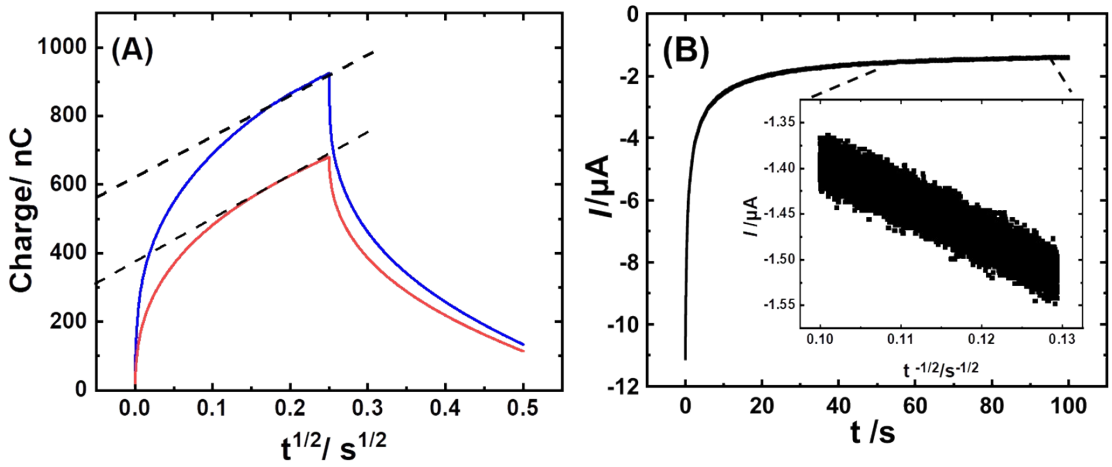

Fig. S2 (A) CC curves at the MCH/Au electrode (red line) and MCH/MB/Au electrode (blue line) in 10 mM Tris-HCl buffer containing 50 μM $Ru(NH_3)_6^{3+}$; (B) i-t curve at the MCH/MB/Au electrode in 5 mM $Ru(NH_3)_6^{3+}$ solution containing 0.1 M KCl, potentiostated at E= -0.2V, time step for current measurement: 0.001 s.

The packing density (Γ_{DNA}) can be calculated according the following equations:

$$\Gamma_{Ru}=\frac{Q}{nFA}$$

$$\Gamma_{DNA}=\Gamma_{Ru}(\frac{Z}{m})N_A$$

Γ_{Ru} is the quantity of the adsorbed $Ru(NH_3)_6^{3+}$, n is the number of electrons involved in the redox reaction, F is Faraday's constant, A is the microscopic area of the electrode, z is the valence of the redox marker $[Ru(NH_3)_6]^{3+}$, m is the number of bases in the DNA probes, and N_A is the Avogadro's constant.

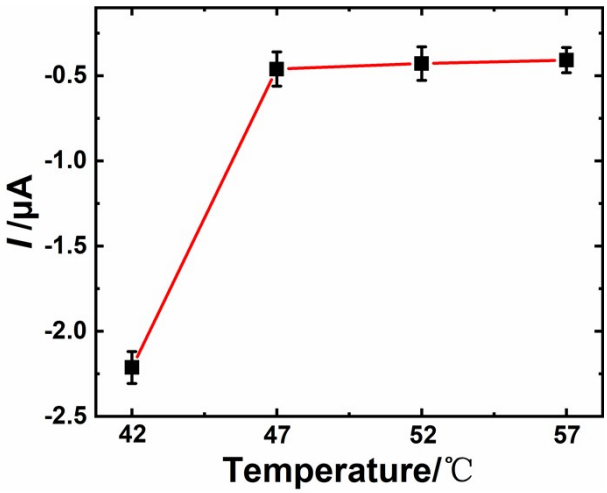

Fig. S3 Effect of reaction temperature, the biosensors was incubated in 2 μM HP and 1 ng/μL FEN 1 in the presence of 10 pM ctDNA for 2h.

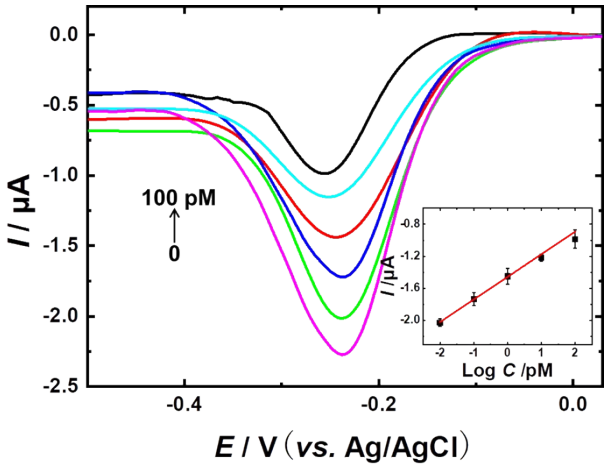

Fig. S4 DPV responses of the biosensor to 0, 0.01, 0.1, 1, 10, 100 pM double-strand DNA, the inset was linear fit plot of peak current vs. logarithm of double-strand DNA concentration

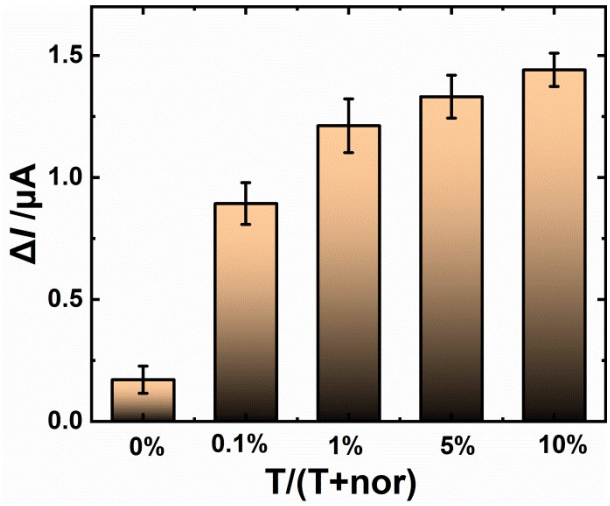

Fig. S5. Selectivity of the proposed biosensors. ΔI of each sample containing T and nor with different proportions. Error bars represent standard deviations of three parallel experiments.

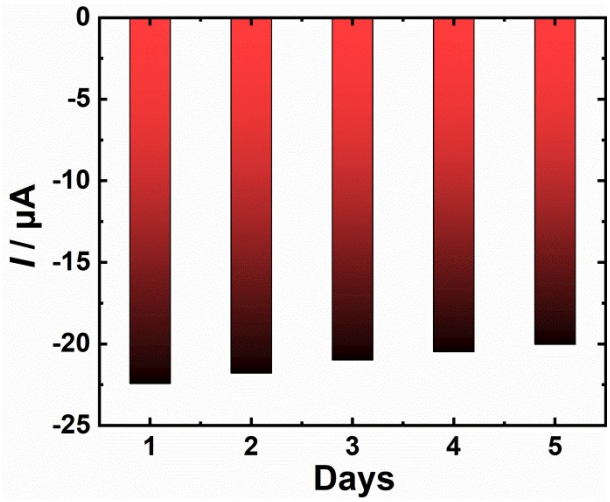

Fig. S6 Stability of the proposed biosensor.

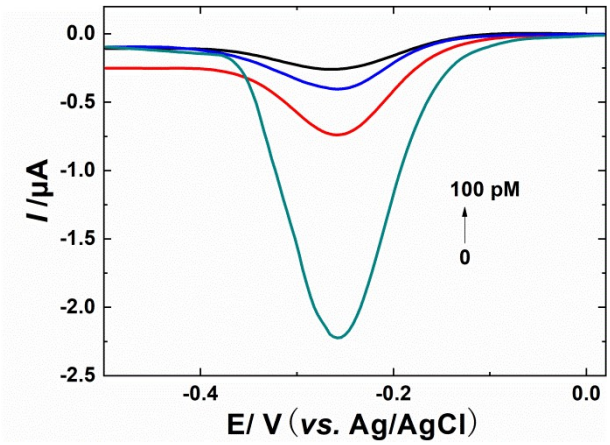

Fig. S7 the DPV responses of the recovery assay of ctDNA in three ten-fold diluted serum samples with standard addition method.