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## **Supporting Information**

# Redox cycling-amplified electrochemical immunosensor for $\alpha\text{-}$

### fetoprotein sensitive detection via polydopamine nanolabels

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### 1. Characterization of nano-gold electrode



Fig. S1 CV curves in 0.5 M  $H_2SO_4$  solution at bare gold electrode and nano-gold electrode.

#### 2. Electrochemical characterization of PDANPs



Fig. S2 CV curves in PBS (0.01 M, pH 8.5) containing FDM (0.5 mM) with the addition of different

concentration of PDANPs.

3. Oxidation charge transfer amplification mechanism



Fig. S3 Electrochemical reactions of FDM taking place on the working electrode surface.



Fig. S4 Amount of FDM<sup>+</sup> reduced on electrode surface decreases in the presence of  $QH_2$ .

#### 4. XPS-related characterization



Fig. S5 Full XPS spectra for PDANPs.



**Fig. S6** High-resolution XPS spectra of C 1s regions for (A) PDANPs, (B) PDANPs electrochemically treated by CV for 5000 cycles in PBS (0.01 M, pH 8.5) without FDM and (C) PDANPs treated using CV for 5000 cycles in PBS (0.01

M, pH 8.5) containing FDM (0.5 mM).



**Fig. S7** High-resolution XPS spectra of N 1s regions for (A) PDANPs, (B) PDANPs electrochemically treated by CV for 5000 cycles in PBS (0.01 M, pH 8.5) without FDM and (C) PDANPs treated using CV for 5000 cycles in PBS (0.01

M, pH 8.5) containing FDM (0.5 mM).