Supporting Information

Experimental details

Materials

DNA primer, 5′-HS$(CH_2)_6$-TTTTTTAATCCGTCGAGCAGAGTT-3′, is synthesized by Sangon Biotech (Shanghai) Co., Ltd and purified using the PAGE method. The dNTP mix is purchased from Bioer Technology CO., Ltd. Glycol-bis-(2-aminoethylether)-N,N,N',N'-tetraacetic acid (EGTA), Phenylmethylsulfonyl fluoride (PMSF), 3-[(3-cholamidopropyl) dimethylammonio]-1-propanesulfonate (CHAPS) are obtained from Bio Basic Inc. (Canada) and use as supplied. Other chemicals employed are all of analytical grade. All the solutions are prepared with double-distilled water, which has been purified with a Milli-Q purification system.

Immobilization of the thiolated DNA primer

The piranha solution (H_2SO_4:30%H_2O_2 = 3:1, Caution: Piranha solution reacts violently with organic materials) is used to eliminate the adsorbed organic materials. The substrate gold electrode (2 mm^2 in area) is soaked in piranha solution for 20 min and rinsed with ethanol and double-distilled water respectively. After that, it is polished to a mirror silk with alumina powder (Al_2O_3) of various particle sizes (0.05 and 1.0 μm) and washed with Milli-Q water. Then, the gold electrode is activated with 0.1M H_2SO_4 by cyclic voltammetry (CV) method for 10min and rinsed again with double-distilled water. Finally, a solution containing 10μM primer DNA is

dripped on the pretreated electrode held upside and kept in a closed container for 2 hours at room temperature. The resulting electrode is soaked in Tris–HCl buffer for 30min and rinsed with double-distilled water for later use.

Preparation of telomerase extracts and extension reaction

Telomerase extracts are prepared using the conventional method described in the reference [12]. HeLa cells are removed from the substrate by trypsinization, twice washes with phosphate buffer solution (pH 7.4) and pelletization at 2000 rpm for 10min at 4°C. Subsequently, the cells are resuspended in a cold CHAPS lysis buffer (10 mM Tris-HCl, pH 7.4, 1 mM $MgCl_2$, 1 mM EGTA, 0.1 mM PMSF, 0.5% CHAPS, and 10% glycerol) at a concentration of 1×10^5 cells/mL, incubated for 30 min in ice, and then centrifuged for 20 min (12000 rpm, 4°C). The supernatant is stored at -20°C for further experiment.

The telomerase extracts from the respective number of cells is introduced into a 50 μL mixture (20 mM Tris-HCl, pH 8.3, 4 mM $MgCl_2$, 1 mM EGTA, 63 mM KCl, 0.05% Tween 20, 2 mM dNTP mix) as the final reaction solution. Then the primer modified electrode is immersed into the reaction mixture and incubated at 37 °C for a certain time allowing the extension reaction by telomerase. For the control experiments, the cell extract is heated for 10 min at 85 °C to inactivate the telomerase.

Electrochemical measurements

All electrochemical measurements are carried out with a CHI Model 660D electrochemical analyzer (CH Instruments, USA). Electrochemical impedance spectroscopy (EIS) measurements have been performed using a three-electrode

system with an Ag/AgCl reference electrode, a Pt counter electrode, and the working electrode of the primer-immobilized electrode. The system is immersed in 10 mM PBS (pH 7.4) containing 5 mM $Fe(CN)_6^{3-}/Fe(CN)_6^{4-}$ and 0.1 M KCl.