Supporting Information

Experimental details

Materials

DNA primer, 5′-HS(CH2)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 (H2SO4:30%H2O2 = 3:1, Caution: Piranha solution reacts violently with organic materials) is used to eliminate the adsorbed organic materials. The substrate gold electrode (2 mm² 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 (Al2O3) 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 H2SO4 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
30 min 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
10 min at 4°C. Subsequently, the cells are resuspended in a cold CHAPS lysis buffer
(10 mM Tris-HCl, pH 7.4, 1 mM MgCl₂, 1 mM EGTA, 0.1 mM PMSF, 0.5% CHAPS,
and 10% glycerol) at a concentration of 1×10⁵ 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 MgCl₂, 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.