Electronic Supplementary Information

Metal Ions Triggered Ligase Activity for Rolling Circle Amplification and Its Application in Molecular Logic Gate Operations

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Detection of Ag^+.

Sensitivity.

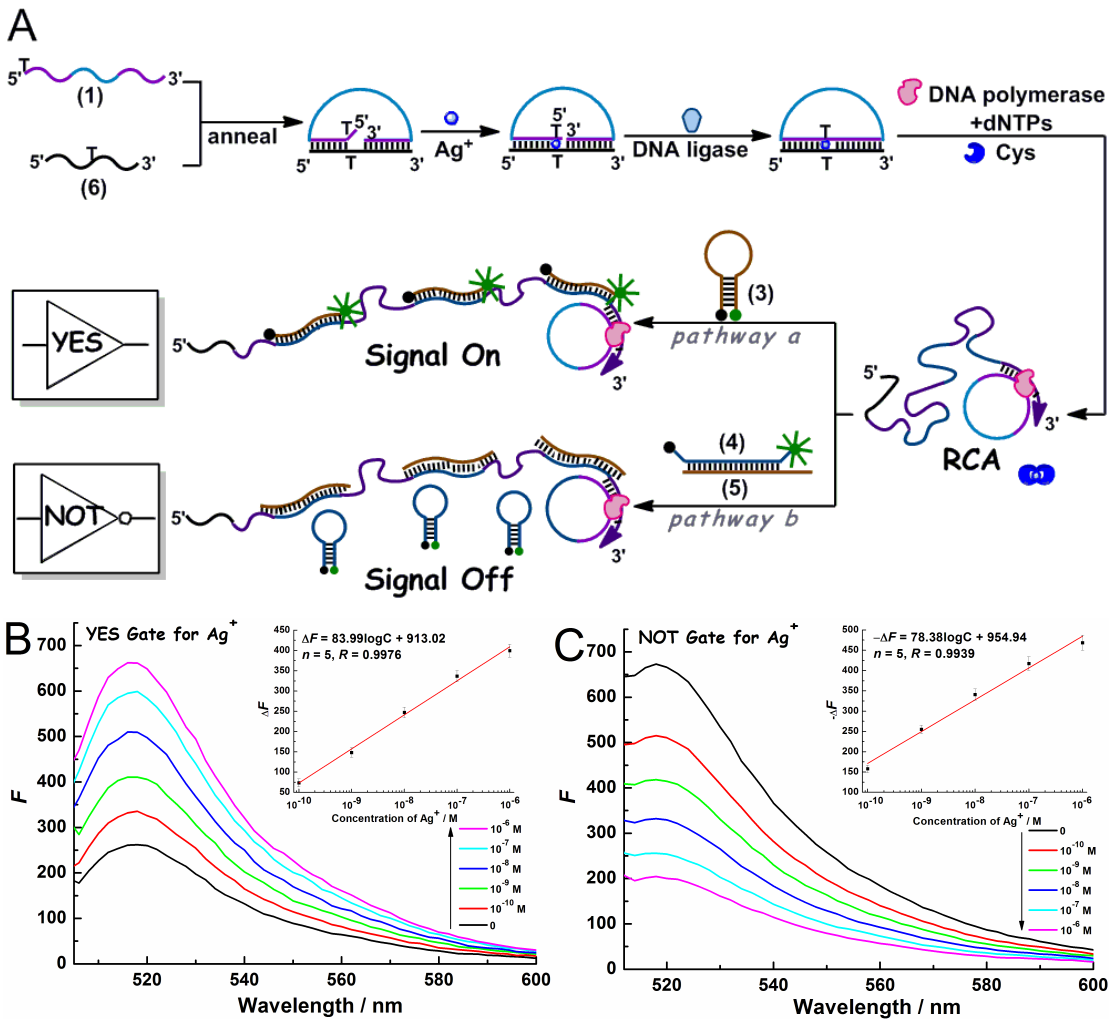


Fig. S1 (A) Diagrammatic representation of DNA ligase activity triggered by Ag^+, which further initiates RCA reaction in the presence of DNA polymerase/dNTPs. Molecular beacon probe (3) and double-stranded fluorescence probe (4 and 5) are employed as fluorescence reporter to perform "YES" gate (pathway a) and "NOT" gate (pathway b), respectively. MBs (3) and (4) are modified with fluorescein (FAM) and Dabcyl as fluorophore/quencher coupled to the 5′- and 3′-end, respectively. Fluorescence quenching or emission of the system at λ = 518 nm is defined as a "false" output (0) or true output (1), respectively. (B and C) Fluorescence spectra of FAM corresponding to difference concentrations of Ag^+ in "YES" gate and "NOT" gate, respectively. The arrows indicate the signal changes as increases in Ag^+ concentrations (0, 10^{-10}, 10^{-9}, 10^{-8}, 10^{-7},

and 10^{-6} M). Insets: Corresponding calibration curves for various concentrations of Ag^{+}.

Selectivity.

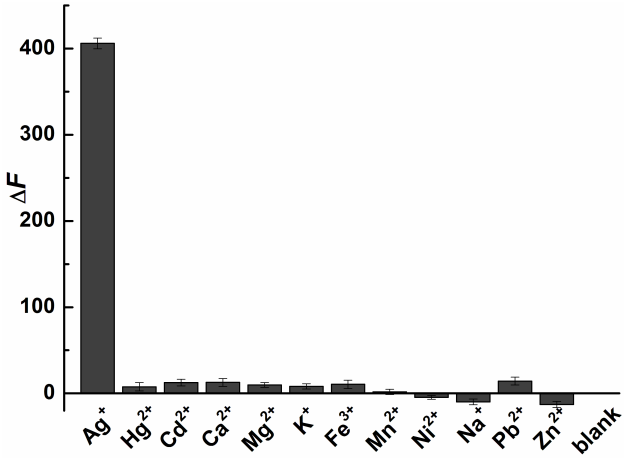
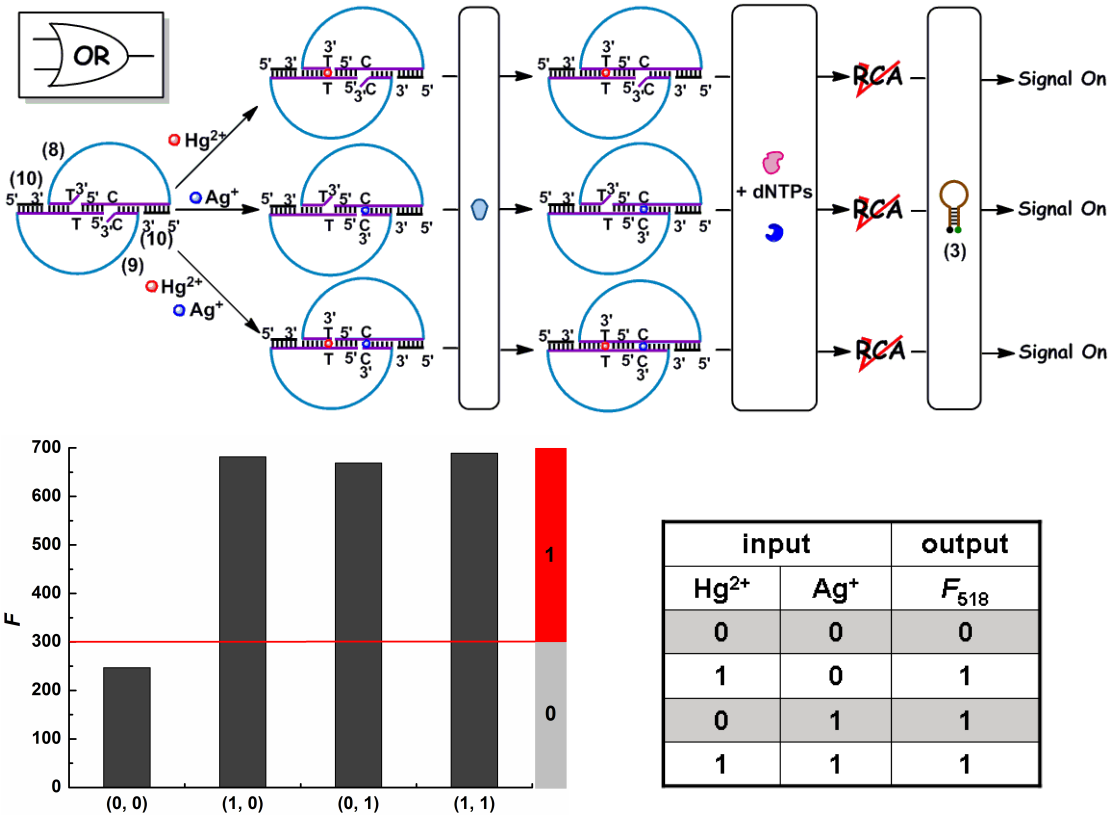


Fig. S2 Selectivity of specific metal ions to trigger the DNA ligase activity. The sequences of padlock probe and primer are the same as those in Fig. S1A which contain a C-C mismatch. The concentration of each metal ion is 1.0 μM.

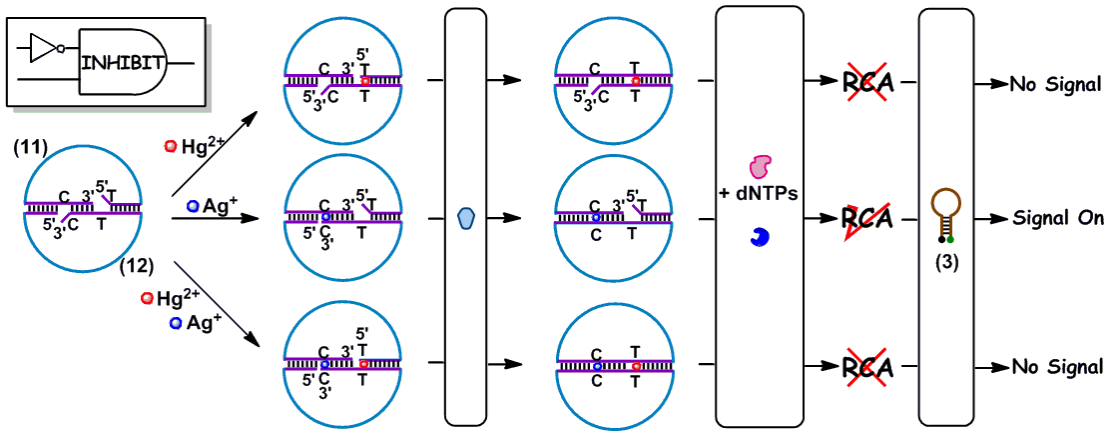
"OR" Logic Gate.

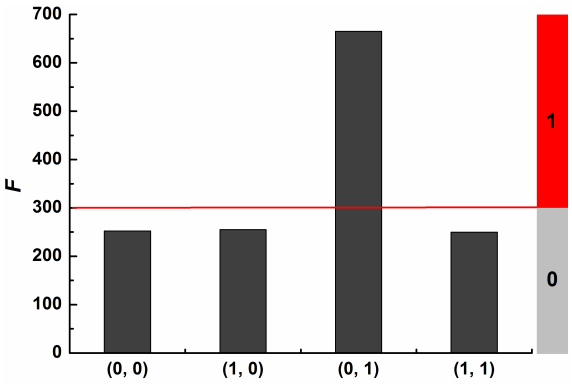


input		output
Hg^{2+}	Ag^{+}	F_{518}
0	0	0
1	0	1
0	1	1
1	1	1

Fig. S3 Diagrammatic representation, fluorescence results and truth table of "OR" logic gate that is activated by Hg^{2+} and Ag^{+} as inputs and connected to molecular beacon probes as reporters to generate fluorescence outputs.

1 **"INHIBIT" Logic Gate.**

2 

3 

input		output
Hg^{2+}	Ag^{+}	F_{518}
0	0	0
1	0	0
0	1	1
1	1	0

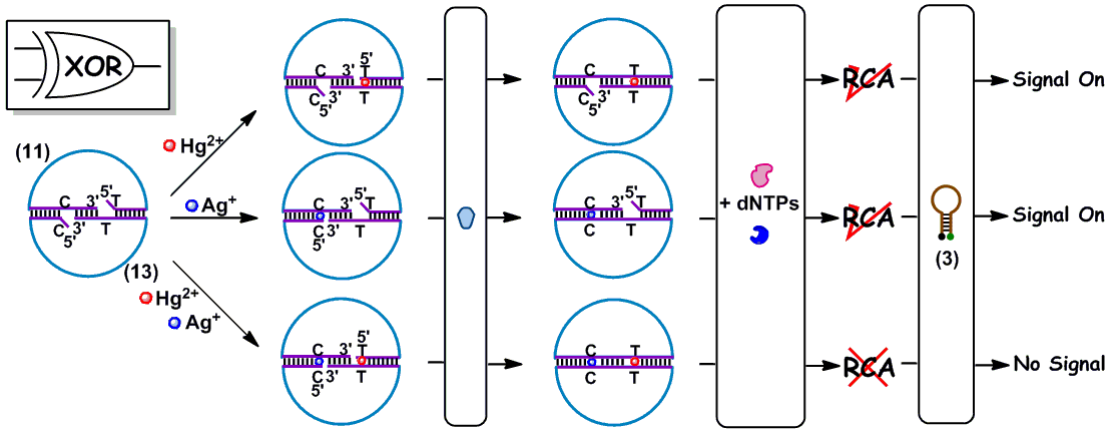
4 **Fig. S4** Diagrammatic representation, fluorescence results and truth table of "INHIBIT" logic gate

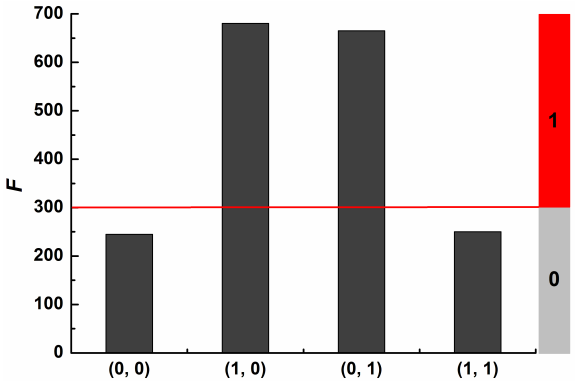
5 that is activated by Hg^{2+} and Ag^{+} as inputs and connected to molecular beacon probes as reporters

6 to generate fluorescence outputs.

7

1 **"XOR" Logic Gate.**

2 

3 

input		output
Hg^{2+}	Ag^{+}	F_{518}
0	0	0
1	0	1
0	1	1
1	1	0

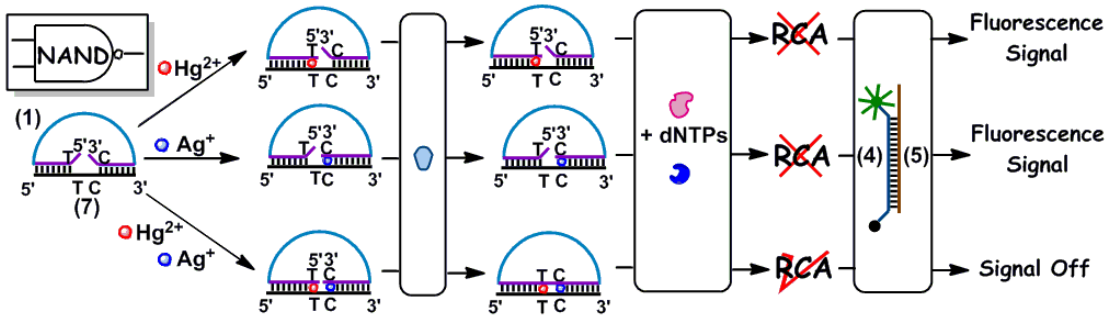
4 **Fig. S5** Diagrammatic representation, fluorescence results and truth table of "XOR" logic gate that

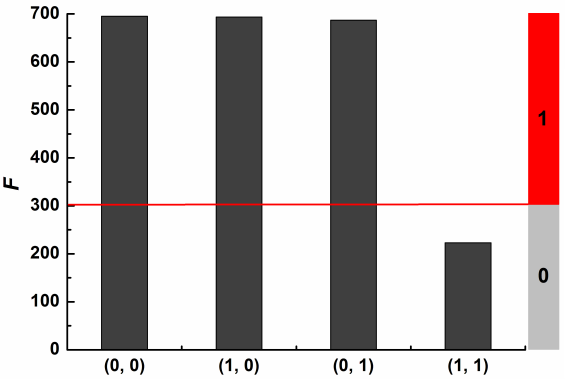
5 is activated by Hg^{2+} and Ag^{+} as inputs and connected to molecular beacon probes as reporters to

6 generate fluorescence outputs.

7

"NAND" Logic Gate.

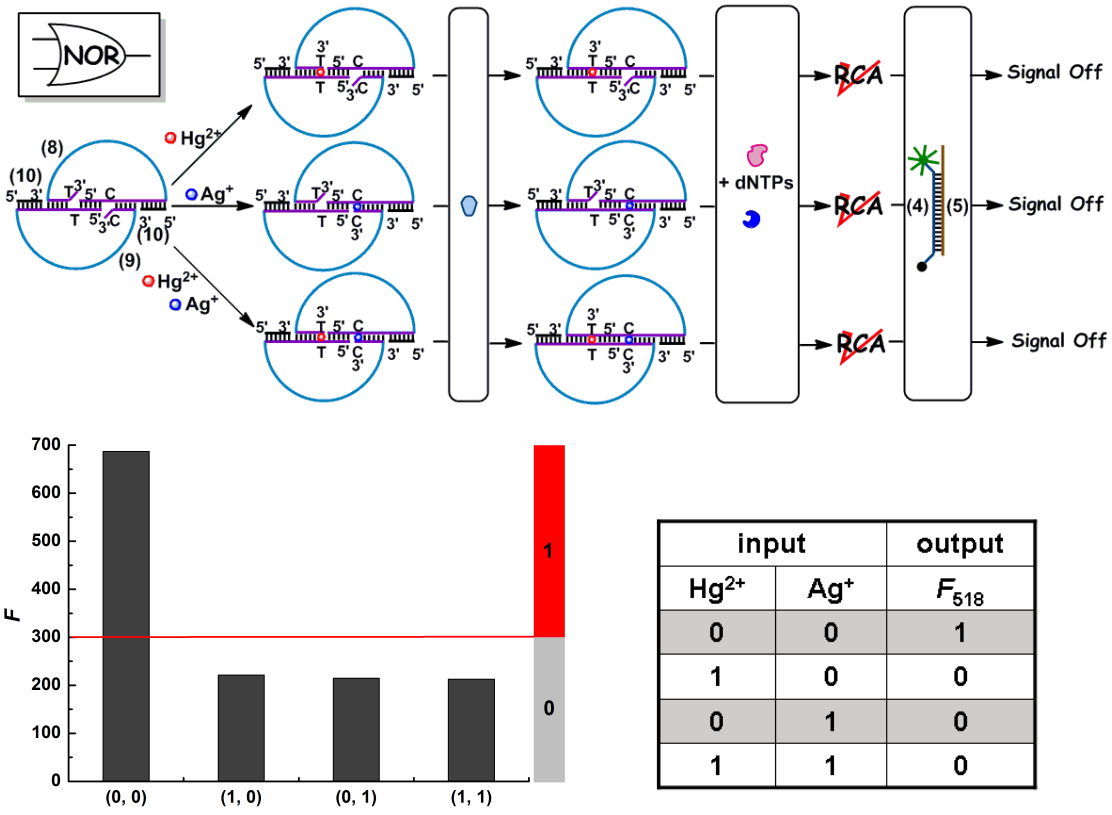




input		output
Hg^{2+}	Ag^{+}	F_{518}
0	0	1
1	0	1
0	1	1
1	1	0

Fig. S6 Diagrammatic representation, fluorescence results and truth table of "NAND" logic gate that is activated by Hg^{2+} and Ag^{+} as inputs and connected to double-stranded fluorescence probes as reporters to generate fluorescence outputs.

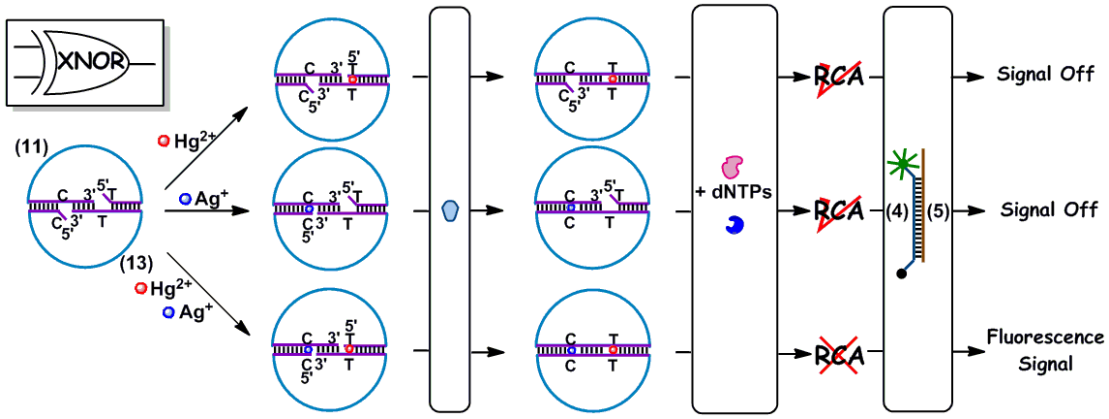
"NOR" Logic Gate.

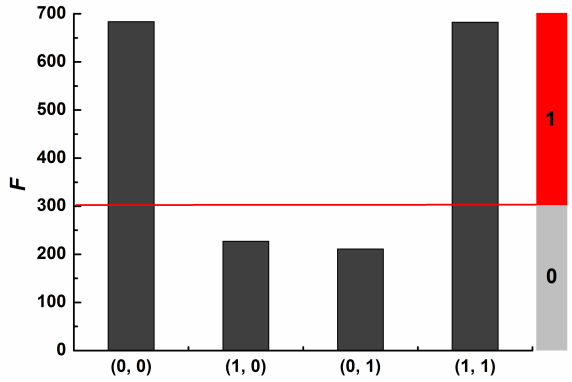


input		output
Hg^{2+}	Ag^{+}	F_{518}
0	0	1
1	0	0
0	1	0
1	1	0

Fig. S7 Diagrammatic representation, fluorescence results and truth table of "NOR" logic gate that is activated by Hg^{2+} and Ag^{+} as inputs and connected to double-stranded fluorescence probes as reporters to generate fluorescence outputs.

"XNOR" Logic Gate.





input		output
Hg^{2+}	Ag^{+}	F_{518}
0	0	1
1	0	0
0	1	0
1	1	1

Fig. S8 Diagrammatic representation, fluorescence results and truth table of "XNOR" logic gate that is activated by Hg^{2+} and Ag^{+} as inputs and connected to double-stranded fluorescence probes as reporters to generate fluorescence outputs.