

## **Supplementary Material**

Figure S1. UV-vis absorption-time course curves in the oxidation of 0.25 mM TMB by 125 mM H<sub>2</sub>O<sub>2</sub> at pH 4 at 25 °C, catalyzed by AG<sub>3</sub>(T<sub>2</sub>AG<sub>3</sub>)<sub>3</sub>-Cu(II) ([Cu<sup>2+</sup>]=0.2  $\mu$ M, [base]/[Cu<sup>2+</sup>]=20) before and after removing unbound Cu<sup>2+</sup> ions through ultrafiltration.



Figure S2. UV-vis absorption-time course curves in the oxidation of 30  $\mu$ M MB by 50 mM H<sub>2</sub>O<sub>2</sub> at pH 11 at 25 °C, catalyzed by 1  $\mu$ M Cu<sup>2+</sup> in the presence of AG<sub>3</sub>(T<sub>2</sub>AG<sub>3</sub>)<sub>3</sub> ([base]/[Cu<sup>2+</sup>]=5, 10, 20) and GMP ([base]/[Cu<sup>2+</sup>]=20).



Figure S3. Fluorescence emission spectra of 2.5 mM TA after 12 h-reaction with 100 mM  $H_2O_2$  at pH 5 at 25 °C, catalyzed by 10  $\mu$ M  $Cu^{2+}$  in the presence of GMP and  $AG_3(T_2AG_3)_3$  ([base]/[ $Cu^{2+}$ ]=20).



Figure S4. CD spectra of (a)  $A(G_4C)_3G_5C$  and (b)  $(CG_3)_2(CG)_2(AG_3)_2G$  in 10 mM MES buffer containing 100 mM NaCl (pH 7.0) titrated with Cu<sup>2+</sup>. The black line represents the spectrum of DNA alone.



Figure S5. Plot of the A<sub>652</sub> signal in the oxidation of 0.25 mM TMB by 125 mM H<sub>2</sub>O<sub>2</sub> at pH 4 at 25 °C, catalyzed by AG<sub>3</sub>(T<sub>2</sub>AG<sub>3</sub>)<sub>3</sub>-Cu(II) ([Cu<sup>2+</sup>]=2  $\mu$ M, [base]/[Cu<sup>2+</sup>]=20) digested by 10 U/mL S1 nuclease at different digestion time.



Figure S6. Plot of the  $A_{652}$  signal in the oxidation of 0.25 mM TMB by 125 mM H<sub>2</sub>O<sub>2</sub> at pH 4 at 25 °C, catalyzed by 2  $\mu$ M Cu<sup>2+</sup> in the absence and presence of different concentration of S1 nuclease. The 1×S1 nuclease buffer contains 30 mM HOAc-NaOAc (pH 4.6), 280 mM NaCl and 1 mM Zn<sup>2+</sup>.

Scaffolds	<i>ν</i> /(μM/min)
GMP	0.3±0.007
$AG_3(T_2AG_3)_3$	5.44±0.08
$A(G_4C)_3G_5C$	4.3±0.27
$G_{10}$	0.88±0.14
$(CG_3)_2(CG)_2(AG_3)_2G$	4.75±0.09

Table S1. The initial rates of 2  $\mu$ M Cu<sup>2+</sup> in the presence of mononucleotides and oligonucleotides ([base]/[Cu<sup>2+</sup>]=20).