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**Supporting Information** 

## Light-Driven Artificial Enzymes for Selective Oxidation of Guanosine Triphosphate Using Water-Soluble POSS Network Polymers

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## **Experimental Section**

**General.** <sup>1</sup>H NMR and <sup>13</sup>C NMR spectra were measured with a JEOL EX–400 (400 MHz for <sup>1</sup>H and 10 MHz for <sup>13</sup>C) spectrometer. <sup>29</sup>Si NMR spectra were measured with a JEOL JNM-A400 (80 MHz) spectrometer. Coupling constants (*J* value) are reported in Hertz. The chemical shifts are expressed in ppm downfield from tetramethylsilane, using residual chloroform ( $\delta = 7.24$  in <sup>1</sup>H NMR,  $\delta = 77.0$  in <sup>13</sup>C NMR) or residual DMSO ( $\delta = 2.49$  in <sup>1</sup>H NMR,  $\delta = 39.5$  in <sup>13</sup>C NMR) as an internal standard. MASS spectra were obtained on a JEOL JMS–SX102A. Emission from the samples was monitored using a Perkin Elmer LS50B at 25 °C using 1 cm path length cell. MASS spectra were obtained on a JEOL JMS–SX102A. Synthesis was carried out according to Schemes S1 and S2.

## Synthesis of the naphthyridine ligands, 5.

The compound 1. A reaction mixture containing 9.07 g of malic acid (67.6 mmol) and 6.67 g of 2,6-diaminopyridine (61.1 mmol) was slowly added to 40 mL of 95% H<sub>2</sub>SO<sub>4</sub> at 0 °C. After stirring at 110 °C for 3 h, the solution was neutralized with NH<sub>4</sub>OH, and the product was yielded as a precipitate. Compound 1 was separated by the filtration as a white powder (9.05 g, 92%). <sup>1</sup>H NMR (DMSO- $d_6$ )  $\delta$  11.85 (br, 2H), 7.64 (d, 1H, J = 9.6 Hz), 7.63 (d, 1H, J = 9.2 Hz), 6.32 (d, 1H, J = 9.2 Hz), 6.01 (d, 1H, J = 8.9 Hz).

LRMS (NBA)  $[(M+H)^+]$  calcd. 162, found 162.

The compound 2. A suspension of compound 1 (30.0 g, 93.2 mmol) in 300 mL of acetic anhydride was heated at reflux for 3 h. The resulting mixture was cooled to room temperature. The precipitate was collected by vacuum filtration, washed with diethyl ether, and air-dried to give 32 g (85%) of 2 as a yellow powder. <sup>1</sup>H NMR (DMSO- $d_6$ )  $\delta$  11.90 (s, 1H), 10.50 (s, 1H), 8.02 (d, 1H, J = 8.4 Hz), 7.90 (d, 1H, J = 8.4 Hz), 7.82 (d, 1H, J = 9.2 Hz), 6.40 (d, 1H, J = 9.2 Hz), 2.12 (s, 3H, CH<sub>3</sub>). HRMS (NBA) [(M+H)<sup>+</sup>] calcd. 203.0695, found 203.0694.

**The compound 3.** A mixture of compound **2** (20.0 g, 98.5 mmol) and POCl<sub>3</sub> (350 mL) was heated at 90–95 °C for 2 h. The resulting solution was cooled to room temperature, and excess POCl<sub>3</sub> was removed by Kugelrohr distillation. The residue was dissolved in ice water, and the solution was adjusted under the basic condition (pH = 8) with concentrated ammonium hydroxide, which prompted formation of a brownish green precipitate. The solid was collected by vacuum filtration, air-dried, and continuously extracted (Soxhlet extraction) with chloroform for 12 h. The solvent was removed *in vacuo*, and the crude product was purified by column chromatography (CH<sub>3</sub>OH/CH<sub>2</sub>Cl<sub>2</sub>,

1 : 9 v/v) to give 13 g (60%) of **3** as metallic yellow needles. <sup>1</sup>H NMR (DMSO- $d_6$ )  $\delta$ 11.13 (s, 1H), 8.40 (m, 3H), 7.54 (d, 1H, J = 8.5 Hz), 2.16 (s, 3H). <sup>13</sup>C NMR (DMSO- $d_6$ )  $\delta$  170.41, 155.13, 154.18, 152.76, 140.42, 139.66, 121.46, 118.99, 115.13, 24.25. Anal. Calcd for C<sub>10</sub>H<sub>8</sub>N<sub>3</sub>ClO: C, 54.19; H, 3.46; N, 18.96. Found: C, 54.07; H, 3.64; N, 18.88.

The compound 4. In a 25-mL round-bottom flask, 310 mg of compound 3 (1.4 mmol), 35 mg of PdCl<sub>2</sub>(PPh<sub>3</sub>)<sub>2</sub> (cat.) and 7.8 mg of CuI (cat.) were stirred in 10 mL of dry THF under argon. To the solution, 2 mL of triethylamine was slowly added through a syringe. The mixture was stirred at room temperature for 30 min and then 0.2 mL of 3-ethynylaniline (1.9 mmol) were added dropwise. The reaction was stirred at room temperature overnight. By removing the volatiles under reduced pressure, the residue was dissolved in dichloromethane, passed through a plug of celite and then washed with ethyl acetate. The solvents were removed under reduced pressure, and the crude product was dried under *vacuo*. Column chromatography in silica gel with an increasing gradient of methanol in dichloromethane (CH<sub>2</sub>Cl<sub>2</sub>/CH<sub>3</sub>OH from 20:1 to 10:1) yielded 180 mg (31%) of **4**. <sup>1</sup>H NMR (DMSO-*d*<sub>6</sub>)  $\delta$  11.02 (s, 1H), 8.43 (m, 3H), 7.65 (m, 1H), 7.11 (t, 1H, *J* = 7.8 Hz), 6.84 (s, 1H), 6.79 (d, 1H, *J* = 7.8 Hz), 6.69 (d, 1H, *J* = 7.8 Hz),

5.32 (s, 2H, NH<sub>2</sub>), 2.20 (s, 3H, CH<sub>3</sub>). <sup>13</sup>C NMR (DMSO-*d*<sub>6</sub>) δ 170.8, 155.4, 155.1, 149.4, 146.3, 139.7, 138.0, 136.9, 129.9, 124.2, 121.7, 119.8, 116.9, 116.1, 115.7, 91.8, 88.8, 24.7.

The compound 5. Compound 4 (4.5 g, 15 mmol) was dissolved in 100 mL of dry methanol, and then succinic anhydride (4.0 g, 40 mmol) was added. The reaction mixture was stirred at room temperature for 6 h. After the reaction, the precipitate was collected by vacuum filtration, and the chloroform solution of the products was washed with methanol and dried over Na<sub>2</sub>SO<sub>4</sub>. After removing volatiles by evaporation, **5** was obtained as a brown powder (4.04 g, 67%). <sup>1</sup>H NMR (DMSO-*d*<sub>6</sub>)  $\delta$  11.07 (s, 1H), 10.15 (s, 1H), 8.43 (m, 3H), 7.99 (s, 1H), 7.72 (m, 1H), 7.60 (m, 1H), 7.42 (m, 1H), 7.33 (m, 1H), 2.58 (m, 4H) 2.18 (s, 3H). <sup>13</sup>C NMR (DMSO-*d*<sub>6</sub>)  $\delta$  177.3, 173.7, 168.9, 157.6, 150.0, 146.3, 143.6, 138.1, 136.9, 133.8, 128.6, 127.9, 126.4, 124.5, 122.9, 121.3, 115.8, 90.3, 86.5, 32.3, 30.7, 22.2. FABMS (NBA/CHCl<sub>3</sub>) *m/z* 266 ([(M+H)<sup>+</sup>]), HRMS (NBA) [(M+H)<sup>+</sup>] calcd. 266.1657, found 266.1657.

**4-(5-Cyanopentyl)-4'-methyl-2,2'-bipyridine, 6.** To a solution of diisopropylamine (4.6 mL, 33 mmol) in THF (100 mL), *n*-butyllithium (1.6 M solution in hexane, 18.4

mL, 29.4 mmol) was added, and the reaction mixture was stirred at -78 °C for 15 min. After adding 4,4'-dimethyl-2,2'-bipyridine (5.16 g, 28 mmol) dissolved in THF (100 mL), the reaction mixture was stirred additionally for 1 h at -78 °C. 5-Bromovaleronitrile (3.6 mL, 31 mmol) in THF (5 mL) was subsequently added, and the reaction mixture was stirred for 2 h at 0 °C. The resulting mixture was diluted with water (100 mL), neutralized with 1 N HCl and extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and concentrated in vacuo. The crude product was purified by silica gel column chromatography (hexane : ethyl acetate = 10:1) to give 7.4 g (99%) of the title compound as a brown powder. <sup>1</sup>H NMR (CDCl<sub>3</sub>)  $\delta$ 8.51 (dd, 1H, J = 0.7, 5.1 Hz), 8.49 (dd, 1H, J = 0.5, 4.9 Hz), 8.19–8.18 (m, 2H), 7.09– 7.06 (m, 2H), 2.66 (t, 2H, J = 7.7 Hz), 2.33 (s, 3H), 2.28 (t, 2H, J = 7.0 Hz), 1.73–1.60 (m, 4H), 1.50–1.44 (m, 2H). <sup>13</sup>C NMR (CDCl<sub>3</sub>)  $\delta$  155.9, 155.6, 151.6, 148.8, 148.6, 147.8, 124.4, 123.5, 121.7, 120.8, 119.3, 34.8, 29.2, 27.9, 24.9, 20.8, 16.7. FABMS  $(NBA/CHCl_3) m/z 266 ([(M+H)^+]), HRMS (NBA) [(M+H)^+] calcd. 266.1657, found$ 266.1657.

6-(4'-Methyl-2,2'-bipyridin-4-yl)hexanoic acid, 7. A mixture of bipyridine 6 (7.40 g, 27.9 mmol) and conc. HCl (35–37 %, 50 mL) was stirred at 100 °C overnight. The

resulting mixture was adjusted the pH value to 4.0–4.5 with 6 *N* NaOH and extracted with chloroform. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and concentrated *in vacuo* to yield bipyridine 7 (7.70 g, 97%) as a magenta powder. <sup>1</sup>H NMR (CDCl<sub>3</sub>)  $\delta$  8.57 (d, 1H, *J* = 0.7 Hz), 8.56 (d, 1H, *J* = 0.7 Hz), 8.21 (s, 1H), 8.18 (d, 1H, *J* = 0.7 Hz), 7.17 (ddd, 1H, *J* = 0.7, 1.6, 5.1 Hz), 7.14 (dd, 1H, *J* = 1.8, 5.1 Hz), 2.72 (t, 2H, *J* = 7.7 Hz), 2.45 (s, 3H), 2.36 (t, 2H, *J* = 7.3 Hz), 1.77–1.67 (m, 4H), 1.46–1.40 (m, 2H). <sup>13</sup>C NMR (CDCl<sub>3</sub>)  $\delta$  177.7, 155.5, 152.8, 148.7, 148.6, 148.5, 148.4 124.7, 124.0, 122.6, 121.8, 35.1, 34.0, 29.7, 28.5, 24.5, 21.1. FABMS (NBA/CHCl<sub>3</sub>) *m/z* 285 [(M+H)<sup>+</sup>], HRMS (NBA) [(M+H)<sup>+</sup>] calcd. 285.1603, found 285.1612.

## Preparationofdichlorobis(4,4'-dimethyl-2,2'-bipyridine)ruthenium(II), $Ru^{II}(bpy)_2$ -Cl2. A mixture containing 4,4'-dimethyl-2,2'-bipyridine (1.417 g, 7.69mmol), RuCl3·3H2O (1.0 g, 3.82 mmol), and lithium chloride (1.1 g, 25.9 mmol) inDMF (10 mL) was refluxed for 7 h. After the reaction, the resulting solution was pouredinto acetone (25 mL) and stored at 5 °C overnight to form the precipitate. The productswere removed by filtration and washed with water (3 × 25 mL) and diethyl ether (3 × 25 mL) before drying in *vacuo* to yield the title compound as a black solid (1.72 g, 83%).The product was used directly in the next step.

**Octaammonium POSS, POSS-[NH<sub>3</sub>Cl]<sub>8</sub>, 8.** (3-Aminopropyl)triethoxysilane (100 mL, 0.427 mol) and conc. hydrochloric acid (35–37 %, 135 mL) in methanol (800 mL) produced **8** as a white precipitate after 5 days at room temperature. The product was obtained after filtration, washing with cold methanol, and drying. The POSS-[NH<sub>3</sub>Cl]<sub>8</sub> was spectroscopically pure in 30% yield (18.8 g). <sup>1</sup>H NMR (DMSO-*d*<sub>6</sub>)  $\delta$  8.23 (s, 24H), 2.76 (t, 16H), 1.71 (m, 16H), 0.72 (t, 16H). <sup>13</sup>C NMR (DMSO-*d*<sub>6</sub>)  $\delta$  40.53, 20.13, and 7.96. <sup>29</sup>Si NMR (DMSO-*d*<sub>6</sub>)  $\delta$  –66.4 (s). MALDI–TOF [(M+H)<sup>+</sup>] calcd. 880.41, found 879.42.

**Compound 9.** In a 200-mL round-bottom flask, 14 g of bipyridine 7 (49 mmol), 7 mL of triethylamine (49 mmol) and 14 g of 4-(4,6-dimethoxy-1,3,5-triazin-2-yl)-4-methylmorpholinium chloride (DMT-MM, 90%) (56 mmol) were stirred in 100 mL of dry methanol until the solid had completely dissolved. To the mixture solution, 20 g of POSS-[NH<sub>3</sub>Cl]<sub>8</sub> **8** (17 mmol) was added. The mixture was stirred at room temperature under argon. After stirring for 24 h, the resulting mixture was evaporated to 20 mL and poured into acetonitrile containing 0.1% HCl. The precipitate was washed with acetonitrile. The POSS derivative containing the bipyridine lignad was obtained to yield

(79%) as a yellowish powder after drying *in vacuo*. <sup>1</sup>H NMR (DMSO-*d<sub>6</sub>*) δ 8.65 (br, 1.2H), 8.55 (br, 0.6H), 8.30 (br, 2.4H), 7.64 (br, 0.6H), 2.94 (br, 1.2H), 2.75 (br, 2H), 2.49 (br, 0.6H), 2.06 (br, 0.6H), 1.71 (br, 2.6H), 1.45 (br, 1.2H), 1.22 (br, 0.6H), 0.70 (s, 2H). <sup>13</sup>C NMR (DMSO-*d<sub>6</sub>*) δ 172.4, 157.1, 154.7, 147.9, 146.7, 146.1, 145.8, 127.5, 126.6, 124.3, 123.4, 99.4, 89.8, 59.8, 41.1, 35.1, 34.6, 29.2, 28.2, 25.1, 20.6, 8.47, and 2.50. <sup>29</sup>Si NMR (DMSO-*d<sub>6</sub>*) δ -66.5 (s). MALDI–TOF [(M+H)<sup>+</sup>] calcd. 1414.17, found 1412.56.

**Compound 10.** 1,8-Naphthyridine ligand **5** (9.9 g, 24.5 mmol), triethylamine (3.5 mL, 24.5 mmol) and DMT-MM (8.9 g, 37 mmol) were stirred in 50 mL of dimethyl sulfoxide (DMSO) until the solid had completely dissolved. To the mixture solution, 23 g of POSS derivative **9** (17 mmol) was added. The mixture was stirred at room temperature under argon. After stirring for 24 h, the resulting mixture was poured into acetonitrile containing 0.1% HCl. The precipitate was collected by vacuum filtration, and washed with acetonitrile. The crude product was dissolved in water and filtrated, and the solvent was removed by a rotary evaporator. The POSS derivative containing the bipyridine and the naphthyridine ligands was obtained as a darkish brown powder (43%). <sup>1</sup>H NMR (DMSO-*d*<sub>6</sub>)  $\delta$  11.10 (s, 1H), 10.46 (s, 1H), 9.91 (s, 1H), 8.62 (br, 32H),

8.25 (br, 98H), 7.64 (br, 32H), 7.21 (br, 11H), 2.74 (br, 86H), 2.45 (br, 51H), 2.06 (br, 22H), 1.83 (br, 28H), 1.66 (br, 66H), 1.44 (br, 43H), 1.21 (br, 22H), 0.63 (br, 72H). <sup>13</sup>C
NMR (DMSO-*d*<sub>6</sub>) δ 172.10, 155.27, 150.01, 147.16, 134.46, 123.61, 120.99, 103.00, 90.55, 82.20, 67.72, 60.92, 52.37, 41.31, 35.25, 34.68, 29.28, 28.24, 25.03, 22.59, 21.30, 20.77, 17.76, and 9.05. <sup>29</sup>Si NMR (DMSO-*d*<sub>6</sub>) δ –66.6.

**POSS-N.** A typical protocol for the polymerization reaction is described here. To a solution of octa-ammonium POSS **8** (13.2 g, 11.2 mmol) and POSS **10** (4 g, 2.2 mmol) in 20 mL of dry methanol, the premixed solution containing 4.03 g of oxalic acid (44.8 mmol), 12.5 mL of triethylamine (89.6 mmol), 24.1 g of DMT-MM (0.1 mol) in dry methanol (100 mL) was added, and the reaction mixture was stirred at room temperature. After stirring for 24 h, the resulting mixture was poured into acetonitrile containing 0.1% HCl, and the precipitate was washed with acetonitrile. The crude product was dissolved in water and filtrated, and the solvent was removed by a rotary evaporator. The title compound was obtained as a darkish red powder (57%) after drying *in vacuo*. <sup>1</sup>H NMR (DMSO-*d*<sub>6</sub>)  $\delta$  11.12 (br, 1H), 10.99 (br, 2H), 10.45 (br, 4H), 8.22 (br, 135H), 7.10 (br, 10H), 3.75 (br, 10H), 3.19 (br, 20H), 2.75 (br, 73H), 2.34 (br, 12H), 2.15 (br, 5H), 2.04 (br, 6H), 1.68 (br, 104H), 1.52 (br, 10H), 1.25 (br, 5H), 0.68

(br, 104H). <sup>13</sup>C NMR (DMSO-*d*<sub>6</sub>) δ 172.41, 161.67, 161.39, 156.51, 155.43, 150.04, 131.36, 127.68, 59.36, 42.45. 41.04, 33.59, 31.91, 28.32, 26.84, 25.29, 22.13, 21.08, 20.65, 10.01, 9.31, 8.52, and 2.83. <sup>29</sup>Si NMR (DMSO-*d*<sub>6</sub>) δ –66.5.

**POSS-Ru.** A mixture containing 1g of POSS-N network polymer (bipyridine unit; 14.5 mg, 0.0508 mmol) and Ru<sup>II</sup>(bpy)<sub>2</sub>Cl<sub>2</sub> (27.4 mg, 0.0508 mmol) was heated at reflux in water (20 mL) for 24 h. The resulting solution was poured into acetonitrile containing 0.1% HCl, and the precipitate was collected by vacuum filtration, washed with acetonitrile. The crude product was dissolved in water and filtrated, and the solvent was removed by a rotary evaporator. The title compound was obtained as a blackish powder (93%). <sup>1</sup>H NMR (D<sub>2</sub>O)  $\delta$  8.86 (br, 1H), 8.42 (br, 3H), 8.05 (br, 1H), 7.73 (br, 11H), 7.25 (br, 2H), 3.58 (br, 6H), 3.14 (br, 74H), 2.80 (s, 1H), 2.72 (s, 1H), 2.54 (br, 2H), 2.36 (br, 1H), 1.91 (br, 63H), 1.71 (br, 2H), 1.47 (br, 2H), 0.91 (br, 63H). <sup>29</sup>Si NMR (D<sub>2</sub>O)  $\delta$  –65.3.

**Encapsulation of nucleoside derivatives.** General procedure for the complexation of guanosine nucleosides by the POSS network polymers is described here. The stock solutions of the POSS-N network polymers (x10) and guanosine nucleosides (x10) were

mixed at room temperature, and then the 500  $\mu$ L of the samples were prepared by adding the PBS buffer (pH 7.4) solution. The complexation with POSS-Ru network polymers was also prepared with the same procedure in PBS buffer solution containing potassium ferricyanide (K<sub>3</sub>[Fe(CN)<sub>6</sub>]).

Fluorescence measurements of the complexes. The fluorescence emissions of the naphthyridine ligand 5 (20  $\mu$ M naphthyridine in the POSS-N network polymer and 10  $\mu$ M the naphthyridine in POSS-Ru network polymer) in the presence and absence of the guanosine nucleosides with the excitation light at 424 nm were monitored using a Perkin Elmer LS50B at 25 °C using 1 cm path length cell. The excitation and the emission bandwidth were 1 nm. The quantum yields were determined as an absolute value with an integral sphere.

Stern–Volmer plots. The data were analyzed with the Stern–Volmer equation:

$$\frac{\mathbf{I}_0}{\mathbf{I}} = 1 + K_{\rm SV} \left[ \mathbf{Q} \right]$$

The emission intensities were plotted according to a Stern–Volmer equation, reporting  $I_0/I$  versus the concentrations of guanosine nucleosides [Q], where  $I_0$  is the intensity in the absence of quencher and I is the intensity in the presence of a quencher

concentration.  $K_{SV}$  is the Stern–Volmer quenching constant. A plot of I<sub>0</sub>/I versus [Q] yields an intercept of one and a slope equals to  $K_{SV}$ .

**Binding constants calculation.** According to the non-emissive complex formation between the 1,8-naphthyridine receptor and guanosine nucleosides, the binding constant  $(K_A)$  can be calculated with the number of the binding molecules (*n*) from the following equation:

$$\log \frac{\text{Io-I}}{\text{I}} = \log K_{\text{A}} + n \log[\text{Q}]$$

Figure 2 in the main text represents the plots for evaluating the  $K_A$  values of the 1,8naphthyridine ligands to GDP and GTP.



Chart 1. <sup>1</sup>H NMR spectrum of the Npt ligand 5.



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**Chart 2.** <sup>1</sup>H NMR spectrum of the bpy ligand 7.



Chart 3. <sup>1</sup>H NMR spectrum of the bpy modified POSS 9.



Chart 4. <sup>1</sup>H NMR spectrum of the Npt-bpy modified POSS 10.



Chart 5. <sup>1</sup>H NMR spectrum of **POSS-N**.



Chart 6. <sup>29</sup>Si NMR spectrum of **POSS-N**.



Chart 7. <sup>1</sup>H NMR spectrum of **POSS-Ru**.

Scheme S1. Synthesis of the ligands<sup>*a*</sup>



<sup>*a*</sup>Reagents and conditions: (a) Malic acid, 95% H<sub>2</sub>SO<sub>4</sub>, 110 °C, 3 h, 92%; (b) acetic anhydride, reflux, 3 h, 85%; (c) POCl<sub>3</sub>, 95 °C, 2 h, 60%; (d) 3-ethynylaniline, PdCl<sub>2</sub>(PPh<sub>3</sub>)<sub>2</sub>, CuI, triethylamine, THF, r.t., 16 h, 31%; (e) succinic anhydride, MeOH, r.t., 12 h, 67%.; (f) (i) LDA, THF, -78 °C, 1 h, (ii) 5-bromovaleronitrile, 0 °C, 2 h, 99%; (g) conc. HCl, 100 °C, 18 h, 97%.



Scheme S2. Synthesis of the network polymers<sup>*a*</sup>

<sup>a</sup>Reagents and conditions: (h) conc. HCl, MeOH, r.t., 5 d, 33%; (j) bipyridine ligand, DMT-MM, triethylamine, MeOH, r.t., 1 d, 79%; (k) Npt ligand, DMT-MM, triethylamine, DMSO, r.t., 1 d, 43%; (l) octaammnium-POSS, oxalic acid, MeOH, r.t., 1 d, 57%; (m) Ru<sup>II</sup>(bpy)<sub>2</sub>Cl<sub>2</sub>, water, reflux, 12 h, 93%.



**Figure S1.** Emission changes of 20  $\mu$ M the naphthyridine ligand in POSS-N by adding each guanosine nucleoside (0  $\mu$ M to 400  $\mu$ M) in PBS buffer solution (pH 7.4) at 25 °C. Excitation wavelength was 364 nm.



**Figure S2.** Emission change of 20  $\mu$ M the naphthyridine ligand in POSS-N by adding 400  $\mu$ M adenosine triphosphate (ATP) in PBS buffer solution (pH 7.4) at 25 °C. Excitation wavelength was 364 nm.



**Figure S3.** (a) UV–vis spectra of 10  $\mu$ M Ru<sup>II</sup>(bpy)<sub>3</sub>·6H<sub>2</sub>O by adding 200  $\mu$ M GTP with 100  $\mu$ M K<sub>3</sub>[Fe(CN)<sub>6</sub>] in PBS buffer solution (pH 7.4) at 25 °C. Photoreactions were performed for 120 min at 25 °C with a 4 W UV-lamp (365 nm). (b) Oxidation ability of Ru<sup>II</sup>(bpy)<sub>3</sub> to GTP was evaluated from the results of HPLC analyses (CH<sub>3</sub>CN/H<sub>2</sub>O form 19:1 to 0:100) (I<sub>G</sub>; intensity of GTP, I<sub>T</sub>; intensity of thymidine, total concentration of GTP and thymidine was fixed).



**Figure S4.** Changes in UV–vis absorption spectra of the solutions containing 10  $\mu$ M naphthyridine ligands in POSS-Ru by adding 200  $\mu$ M (a) rG , (b) GMP, (c) cGMP, and (d) GDP with 100  $\mu$ M K<sub>3</sub>[Fe(CN)<sub>6</sub>] in PBS buffer solution (pH 7.4) at 25 °C. Photoreactions were performed for 120 min at 25 °C with a 4 W UV-Lamp (365 nm).