Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Support Information

Cobalt (II) terpyridine complexes: synthesis, characterization, antiproliferative activity and molecular docking with proteins and DNA

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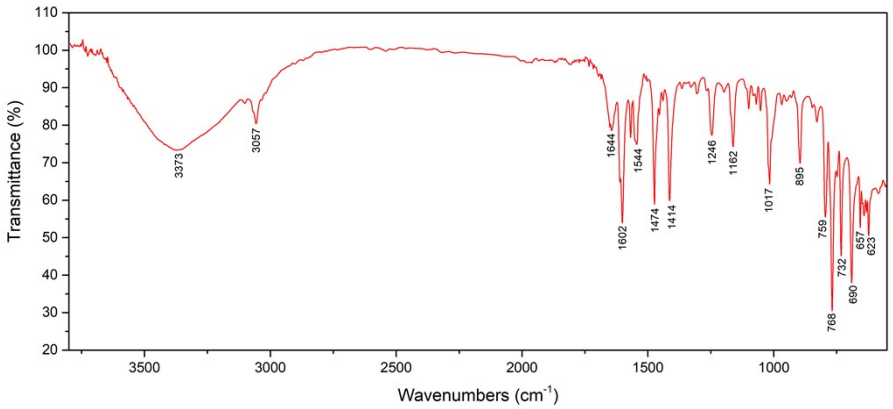

Figure S1. The IR diagram of complex $[Co(\mathbf{L^1})_2]Cl_2$ (**1**)

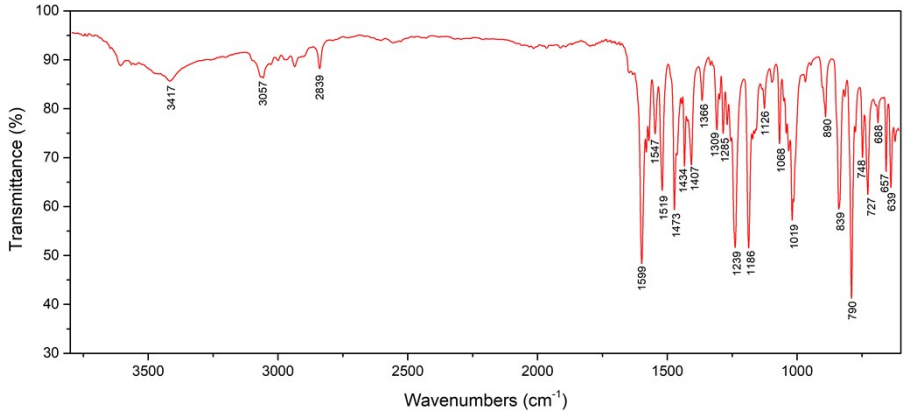

Figure S2. The IR diagram of complex $[Co(\mathbf{L^2})_2]Cl_2$ (**2**)

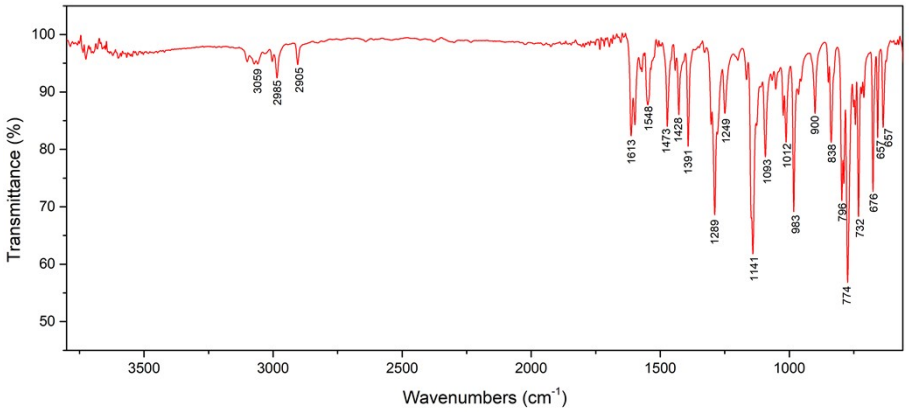

Figure S3. The IR diagram of complex $[Co(\mathbf{L^3})_2]Cl_2$ (**3**)

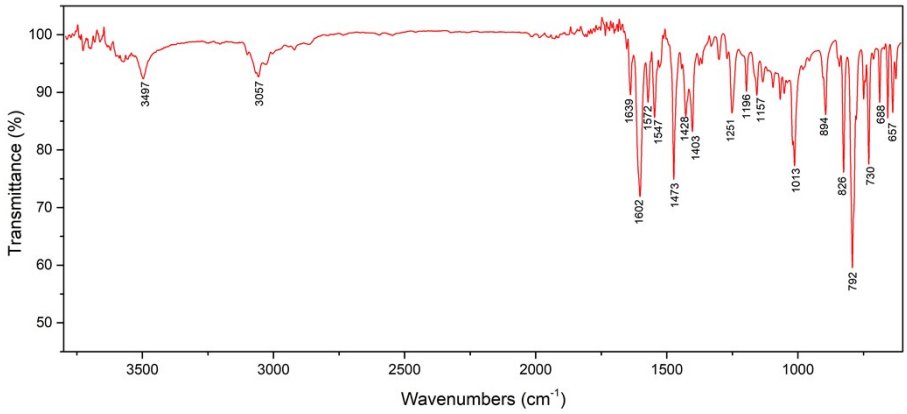

Figure S4. The IR diagram of complex $[Co(\mathbf{L^4})_2]Cl_2$ (**4**)

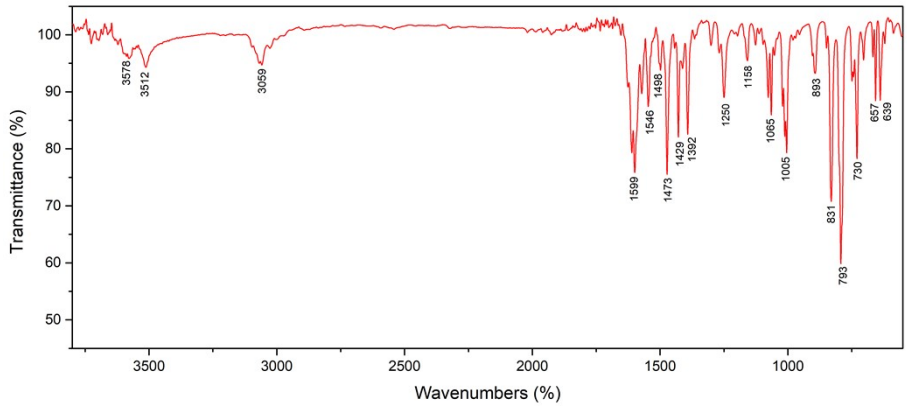

Figure S5. The IR diagram of complex $[Co(\mathbf{L^5})_2]Cl_2$ (**5**)

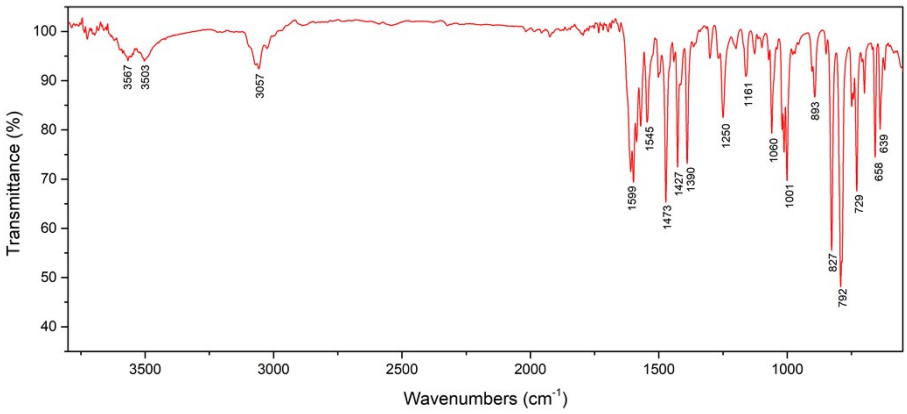

Figure S6. The IR diagram of complex $[Co(\mathbf{L^6})_2]Cl_2$ (**6**)

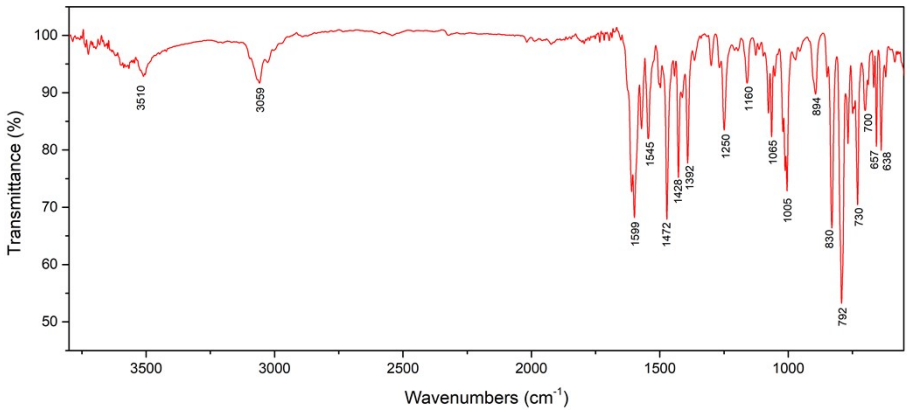

Figure S7. The IR diagram of complex $[Co(\mathbf{L}^{7})_2]Cl_2$ (**7**)

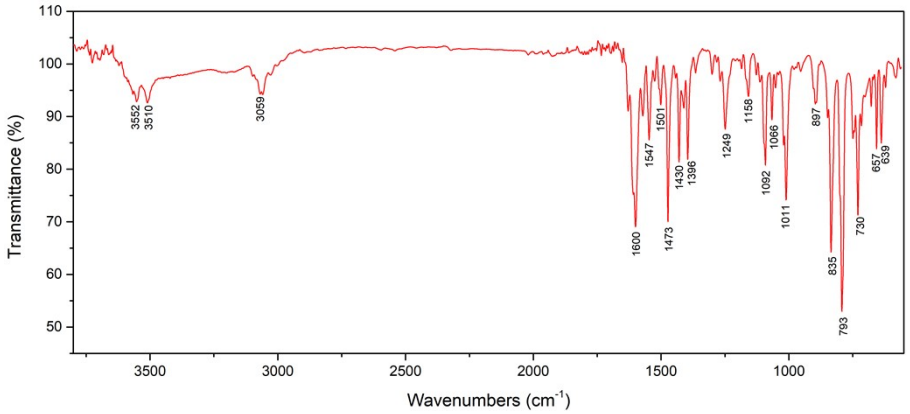

Figure S8. The IR diagram of complex $[Co(\mathbf{L}^{8})_2]Cl_2$ (**8**)

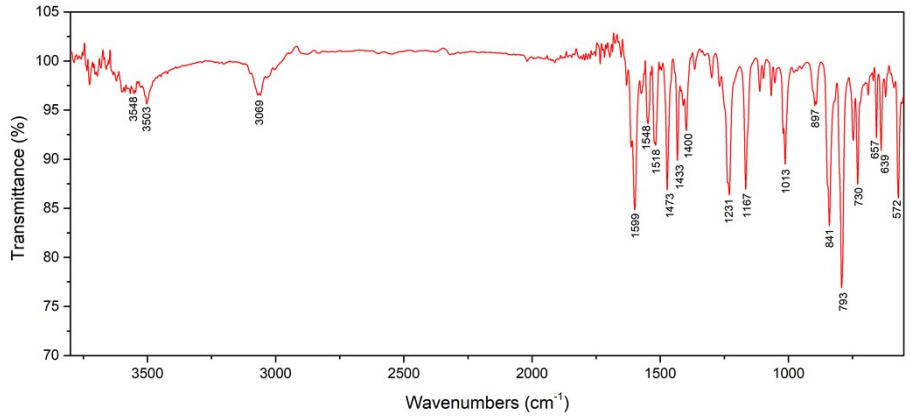

Figure S9. The IR diagram of complex $[Co(\mathbf{L}^{9})_2]Cl_2$ (**9**)

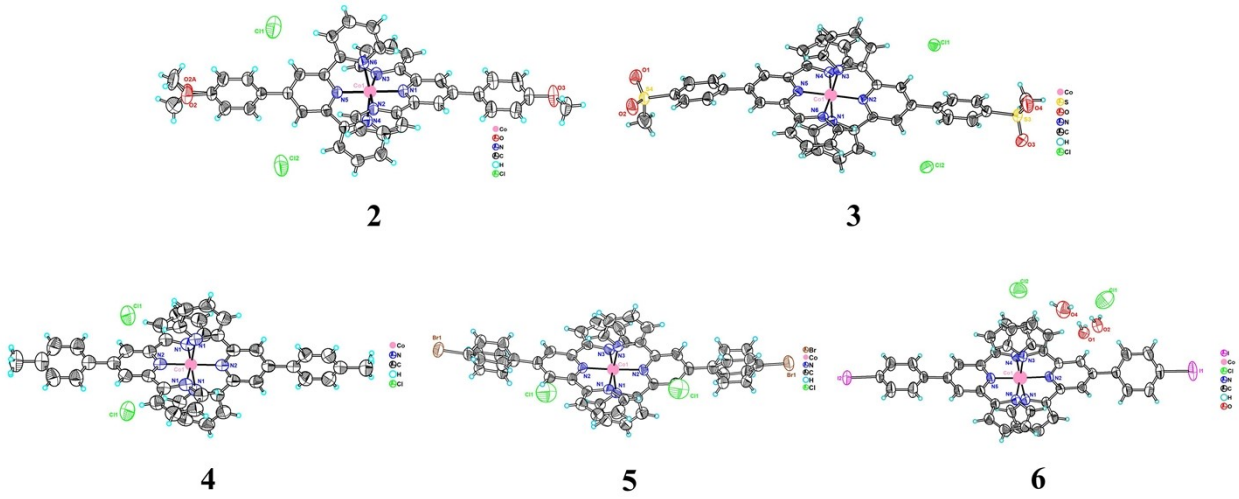

Figure S10. The crystallographic structure diagram of complexes **2-6**.

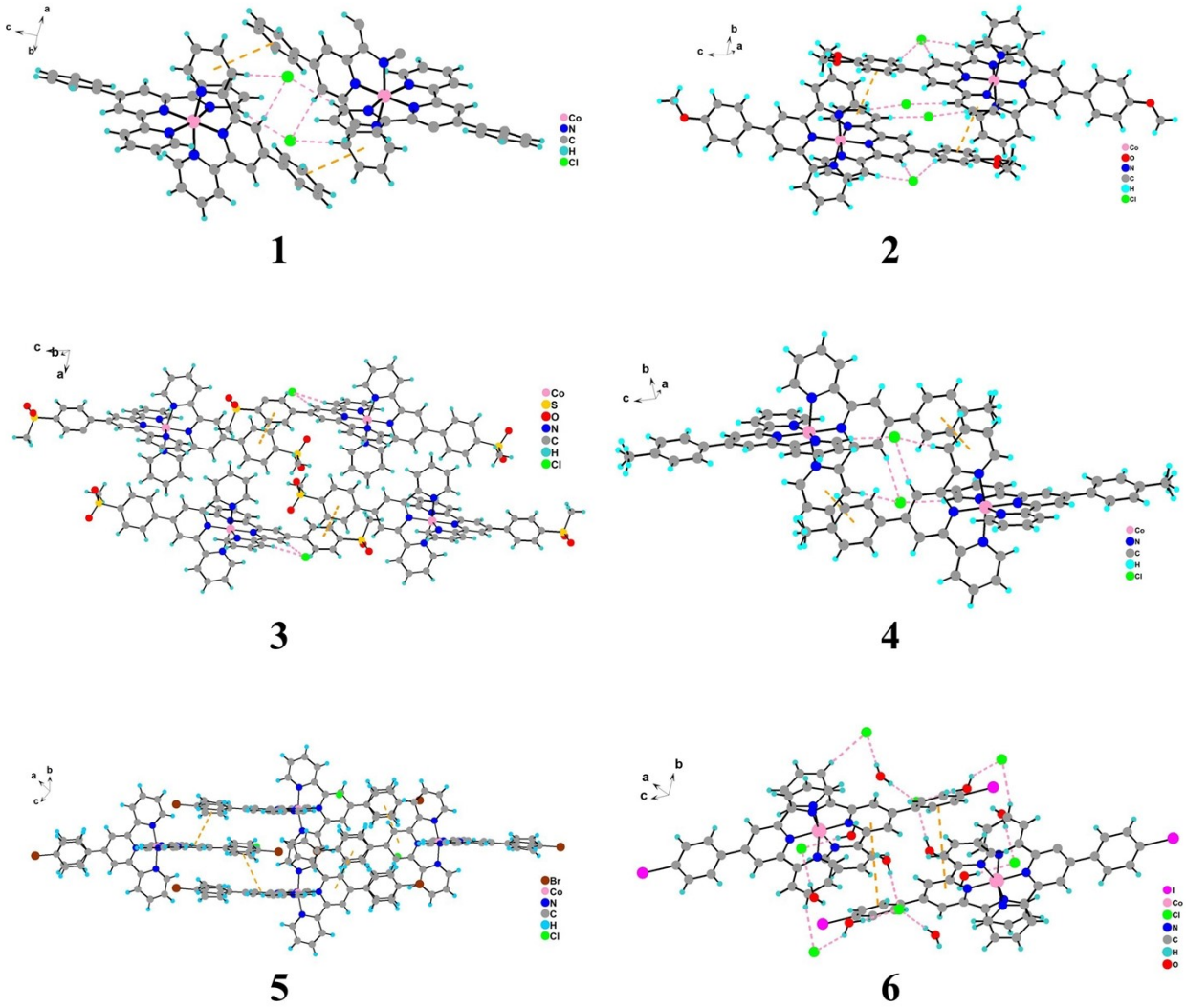

Figure S11. The packing diagram of complex **1-6**.

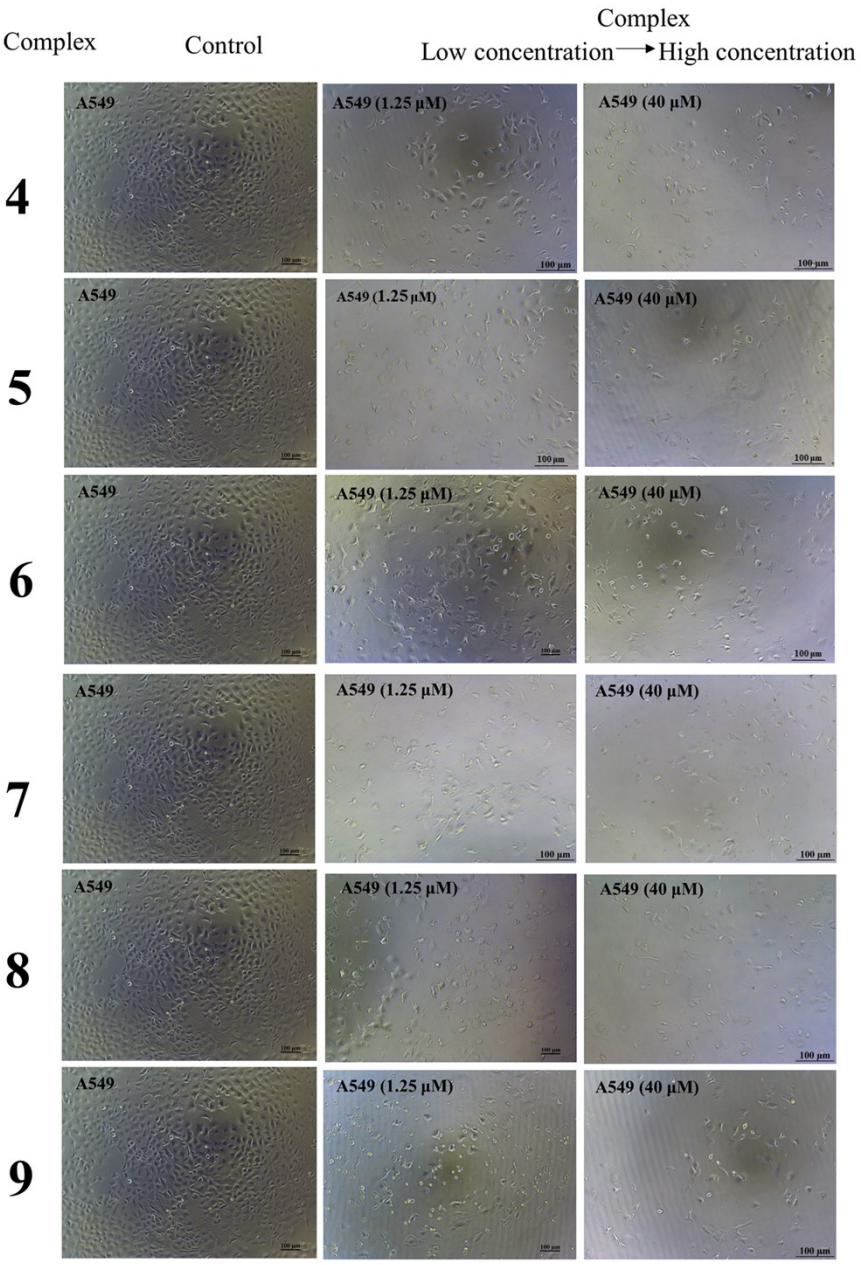

Figure S12. The microscopic images of A549 cells treated with increased concentrations of complexes **4**-**9**.

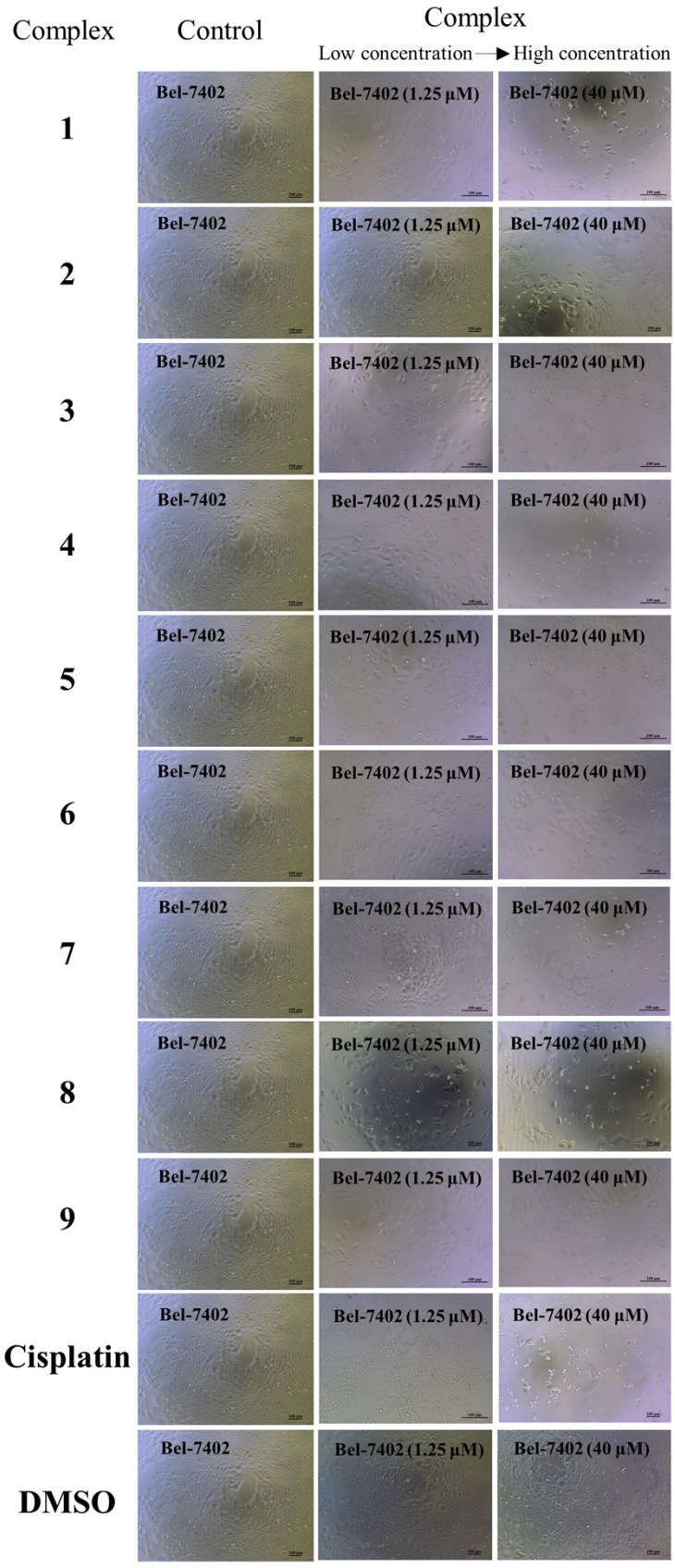

Figure S13. The microscopic images of Bel-7402 cells treated with increased concentrations of complexes **1-9**, cisplatin and DMSO.

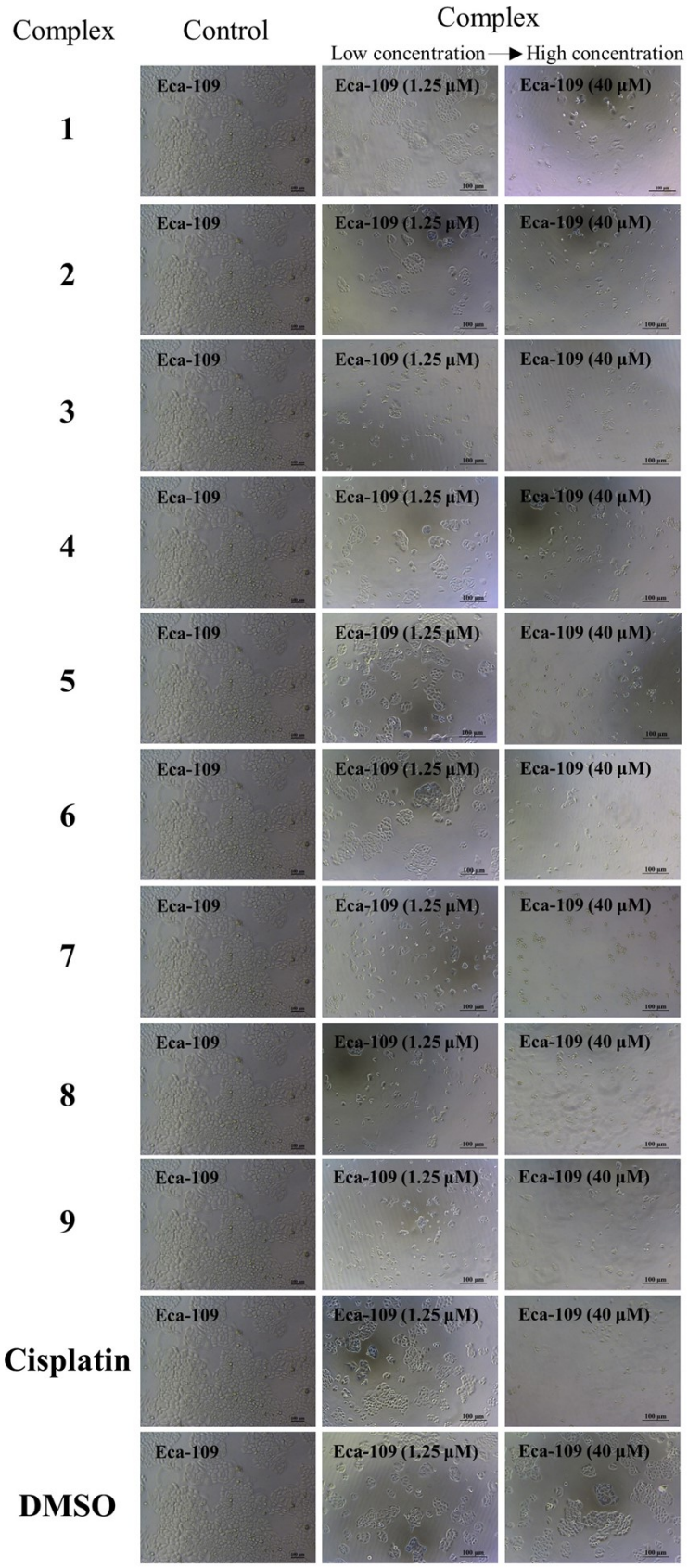

Figure S14. The microscopic images of Eca-109 cells treated with increased concentrations of complexes **1-9**, cisplatin and DMSO.

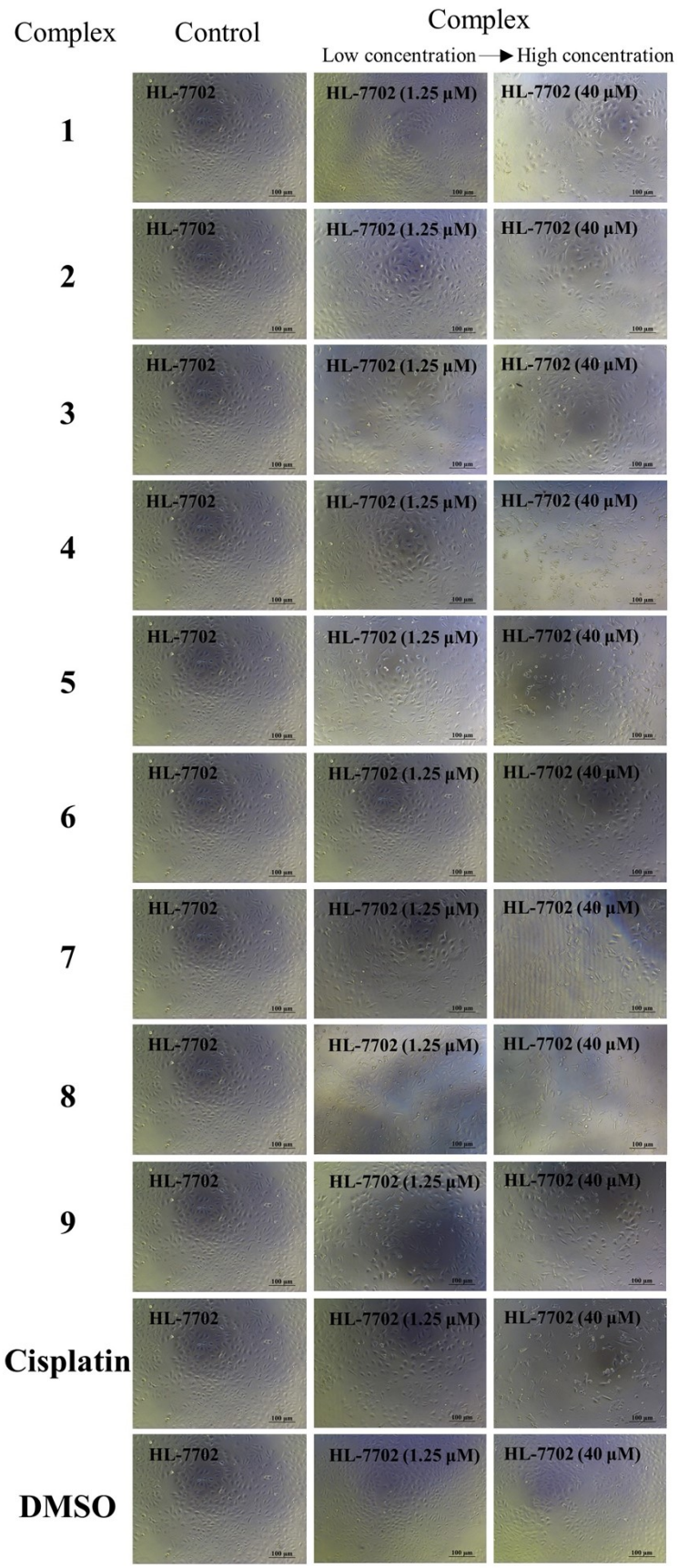

Figure S15. The microscopic images of HL-7702 cells treated with increased concentrations of complexes **1-9**, cisplatin and DMSO.

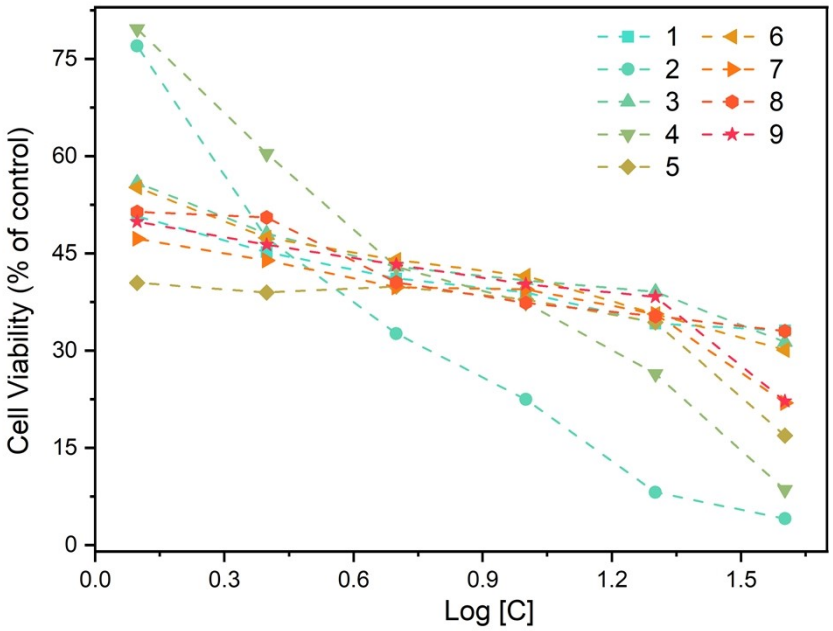

Figure S16. The curves of the cell viability *vs.* the concentration of complexes **1-9** against Bel-7402 cell line.

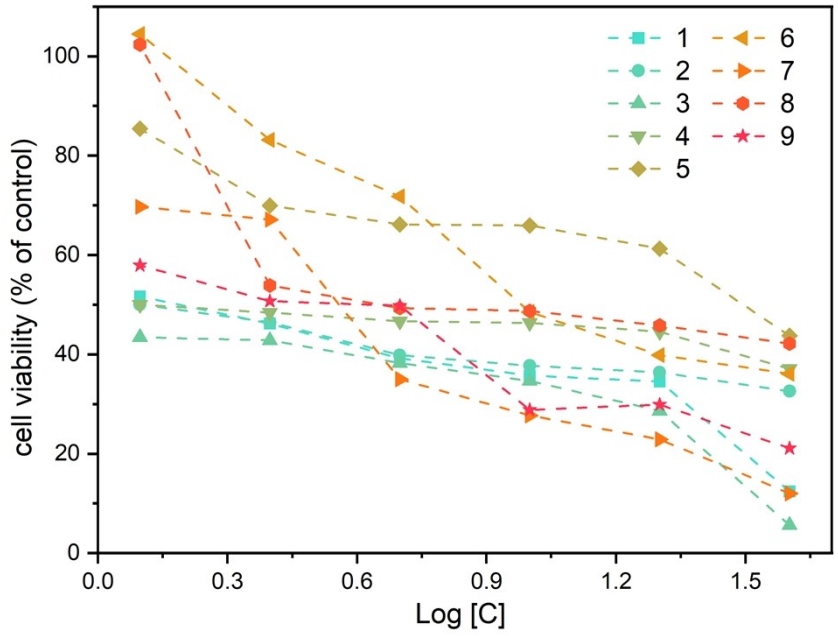

Figure S17. The curves of the cell viability *vs.* the concentration of complexes **1-9** against Eca-109 cell line.

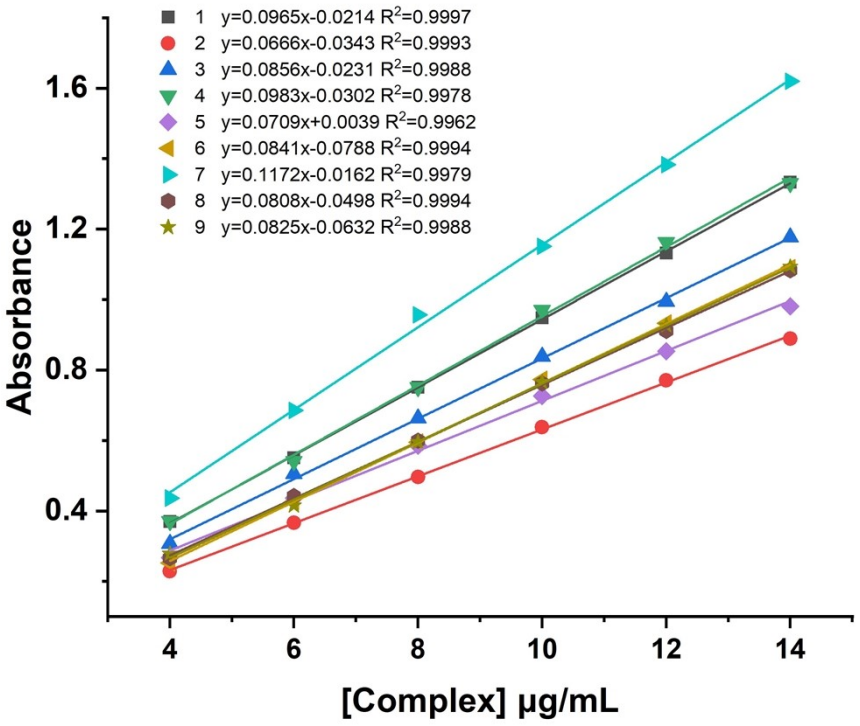

Figure S18. The standard curves of UV-Vis spectra for complexes **1-9**.

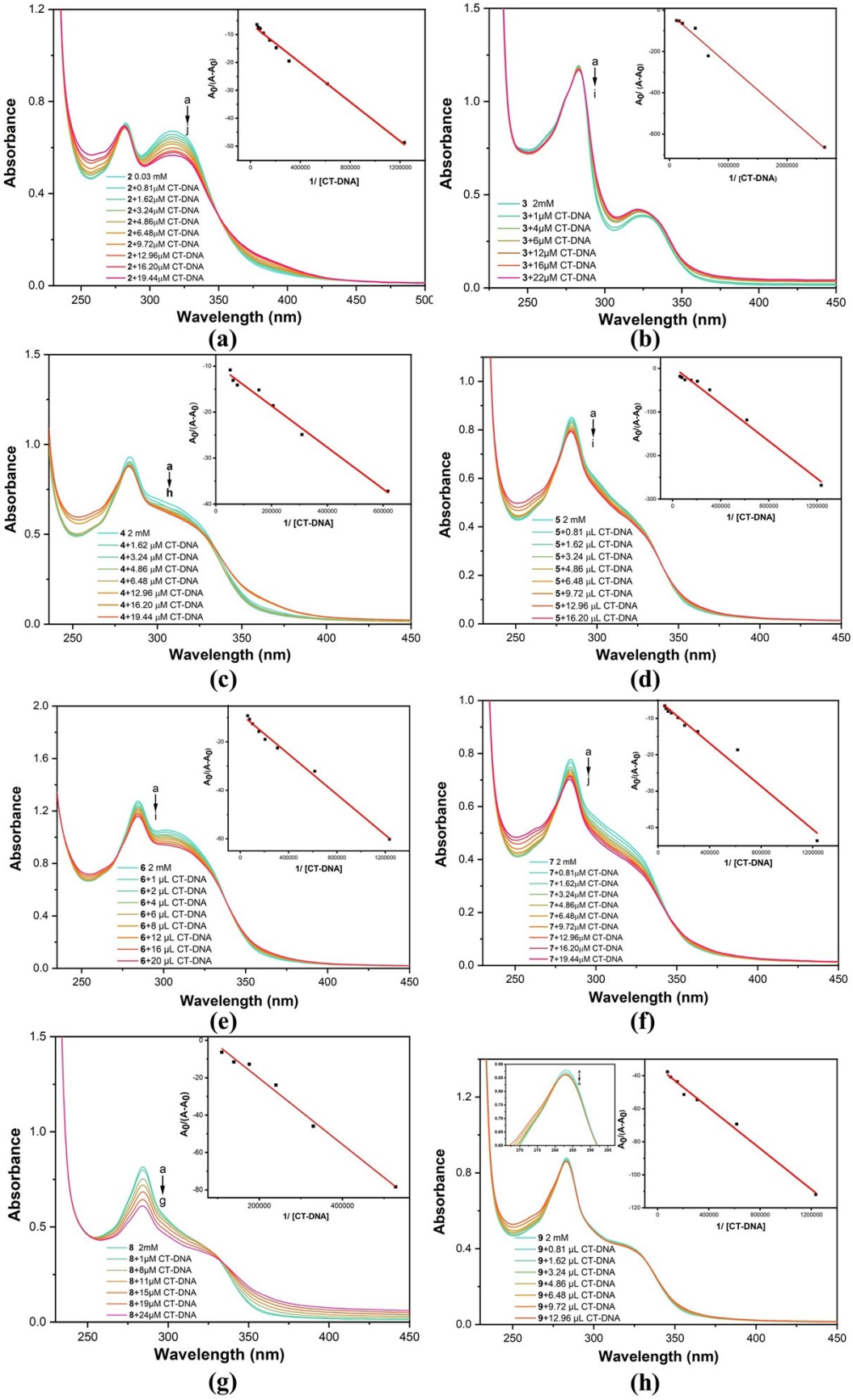

Figure S19. UV-vis spectra of complexes **2-9** (a-h) in the different concentrations of CT-DNA in Tris-HCl 1.0×10^{-3} (pH 7.2).

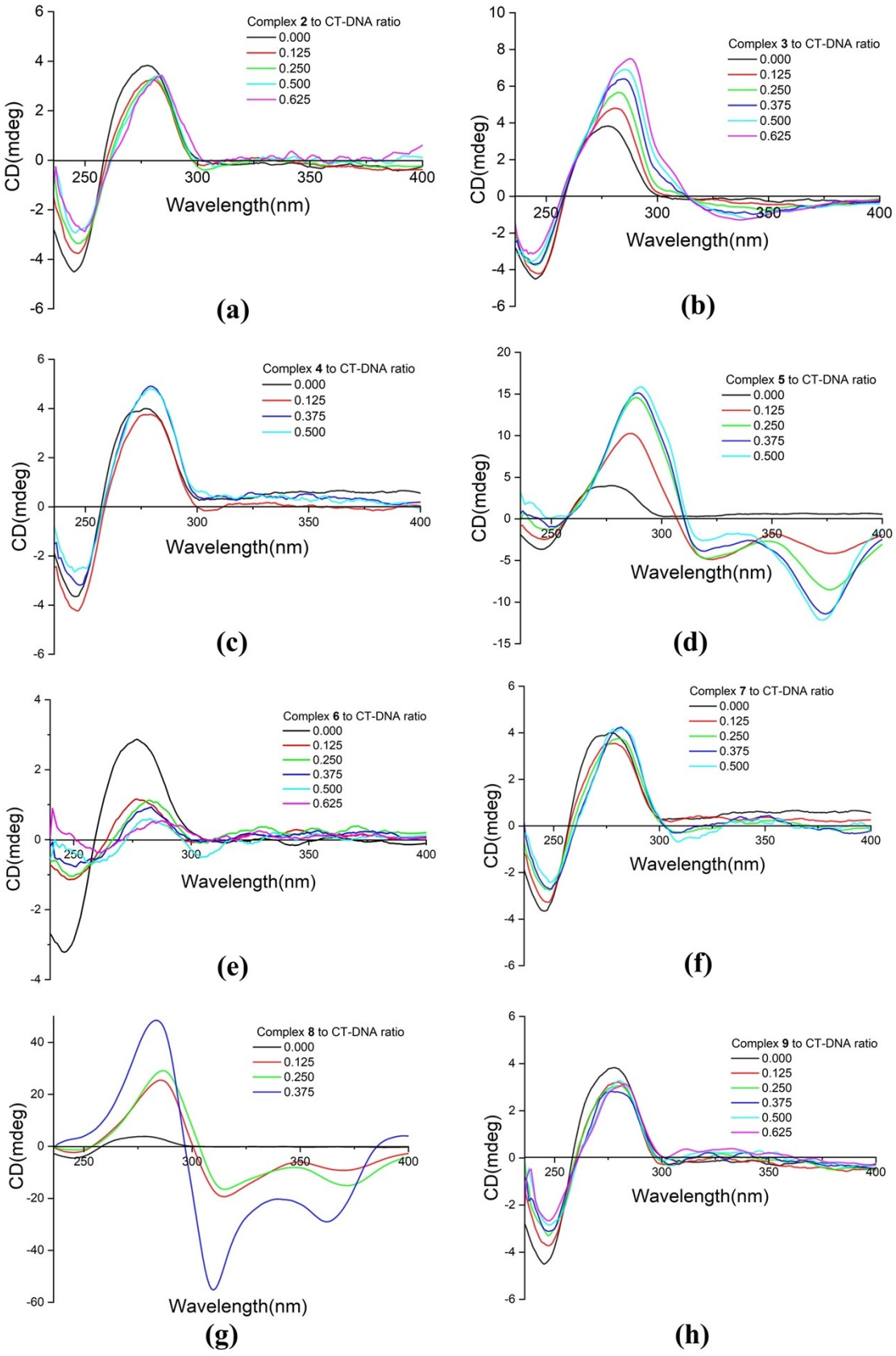

Figure S20. CD spectra of CT-DNA in the presence of complexes **2-9**.

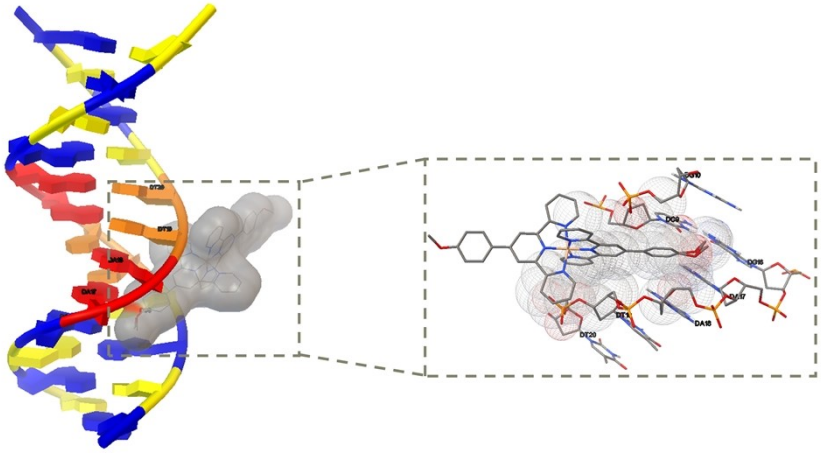

Figure S21. View of the energy minimized docked poses of complex **2** with B-DNA (PDB ID: 1BNA).

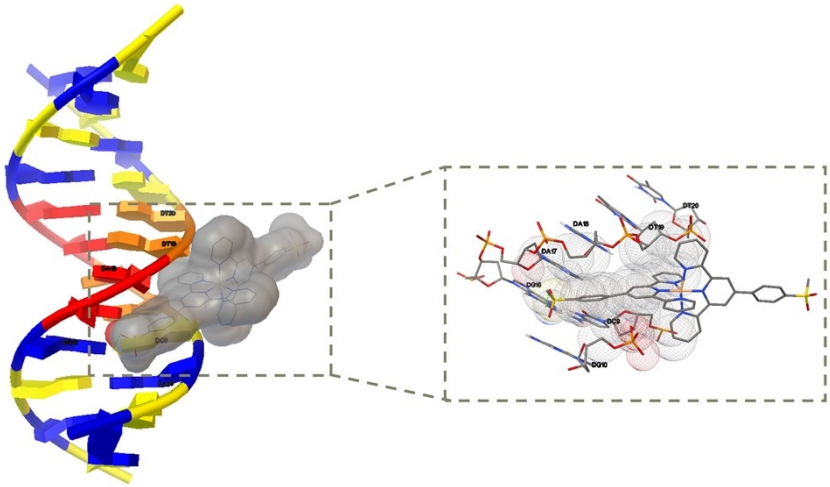

Figure S22. View of the energy minimized docked poses of complex **3** with B-DNA (PDB ID: 1BNA).

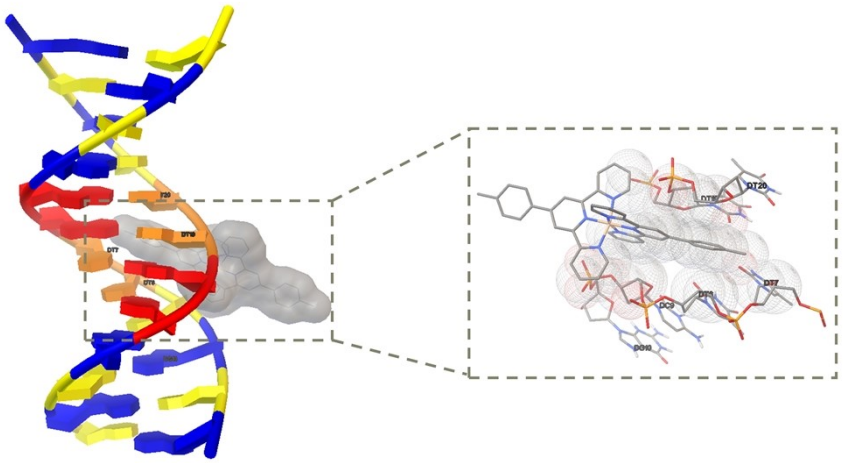

Figure S23. View of the energy minimized docked poses of complex **4** with B-DNA (PDB ID: 1BNA).

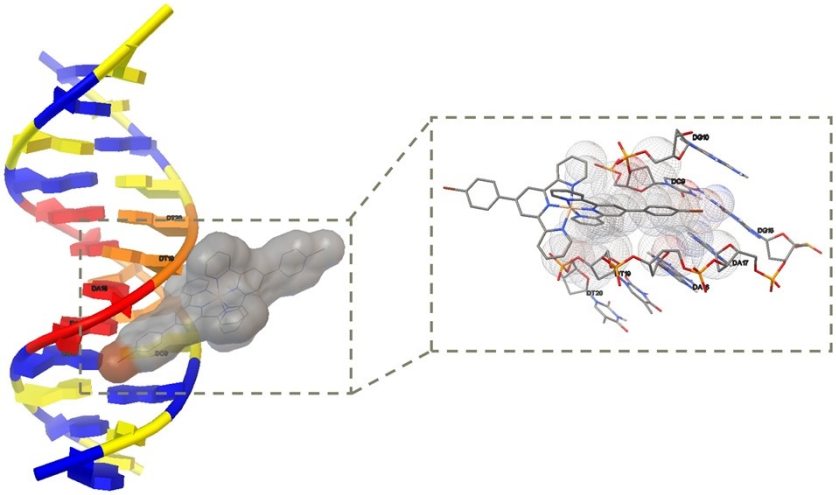

Figure S24. View of the energy minimized docked poses of complex **5** with B-DNA (PDB ID: 1BNA).

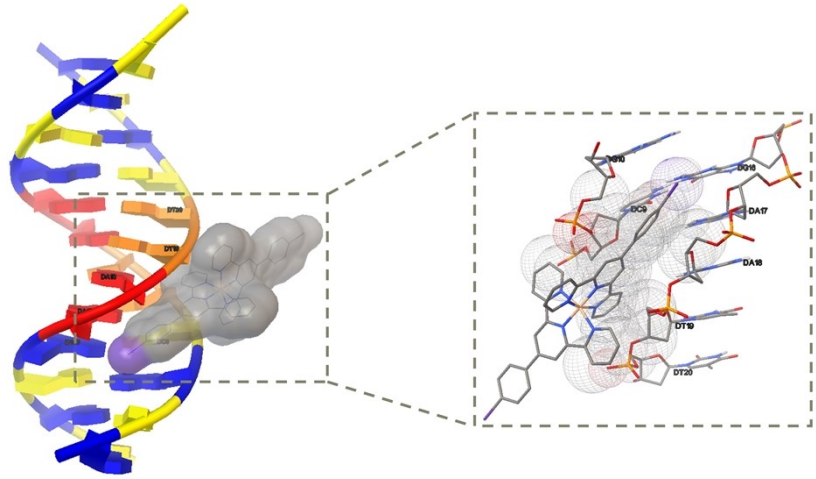

Figure S25. View of the energy minimized docked poses of complex **6** with B-DNA (PDB ID: 1BNA).

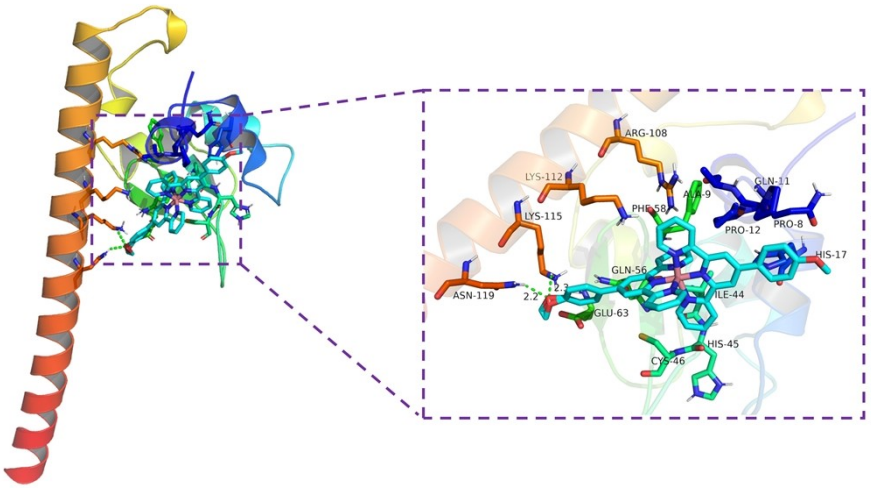

Figure S26. Binding modes of complex **2** with survivin protein (PDB ID: 3UIH).

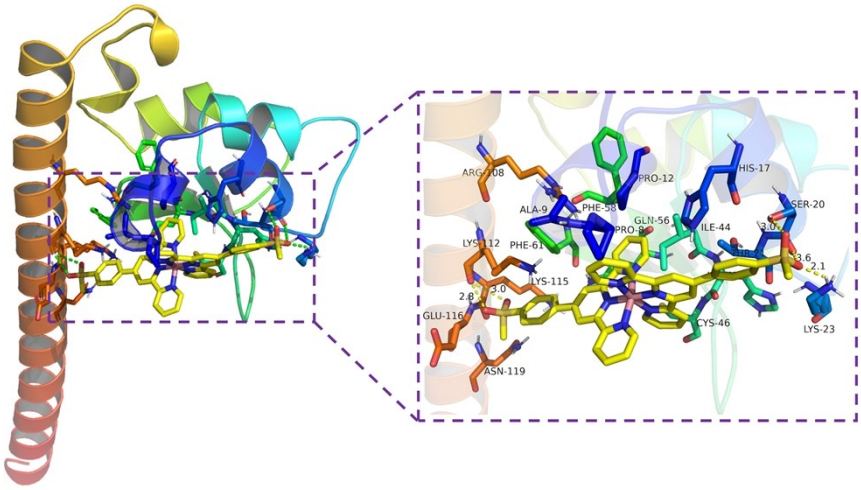

Figure S27. Binding modes of complex **3** with survivin protein (PDB ID: 3UIH).

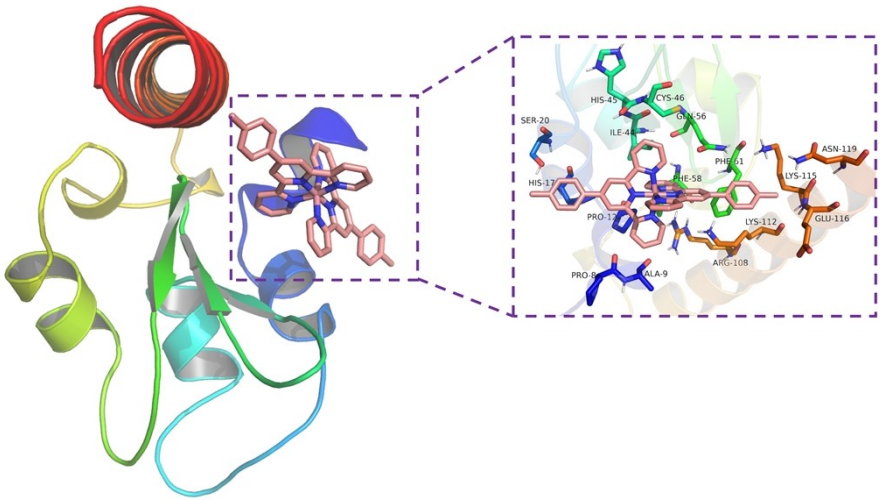

Figure S28. Binding modes of complex **4** with survivin protein (PDB ID: 3UIH).

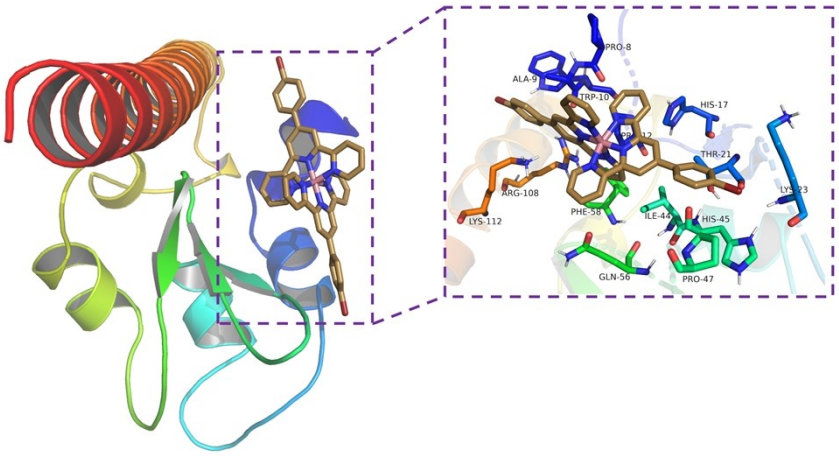

Figure S29. Binding modes of complex **5** with survivin protein (PDB ID: 3UIH).

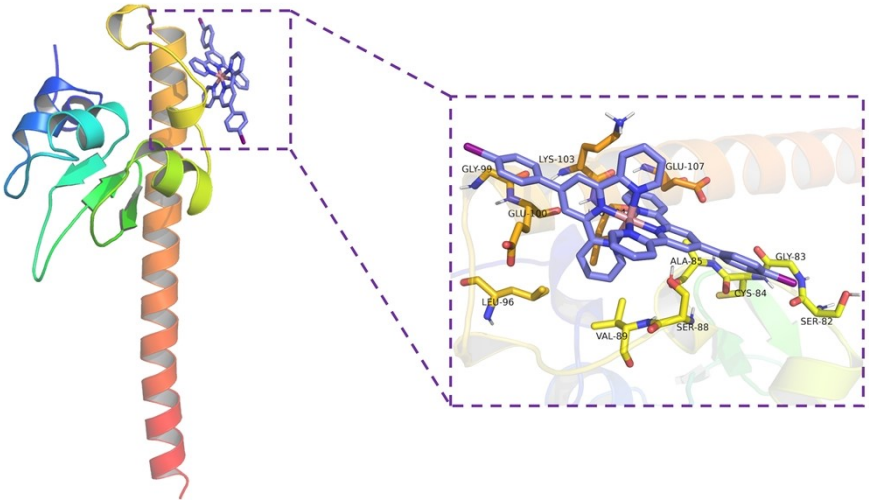

Figure S30. Binding modes of complex **6** with survivin protein (PDB ID: 3UIH).

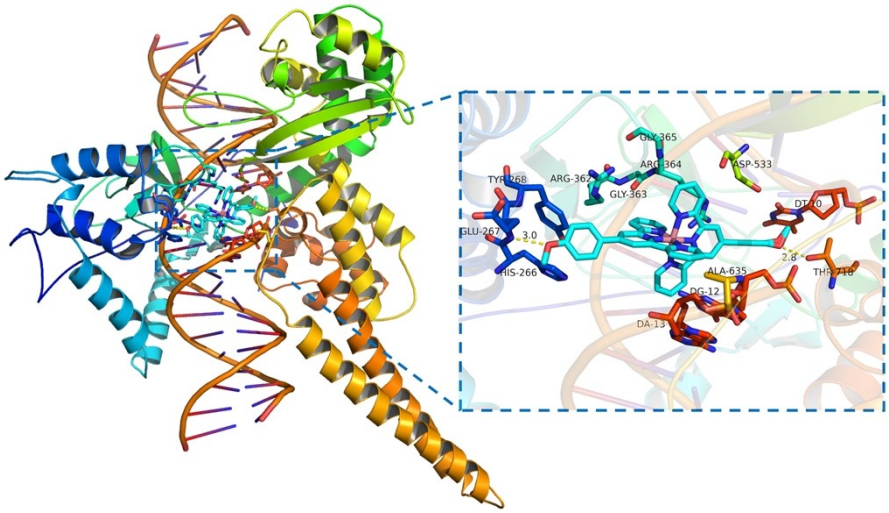

Figure S31. Binding modes of complex **2** with Top I (PDB ID: 1T8I).

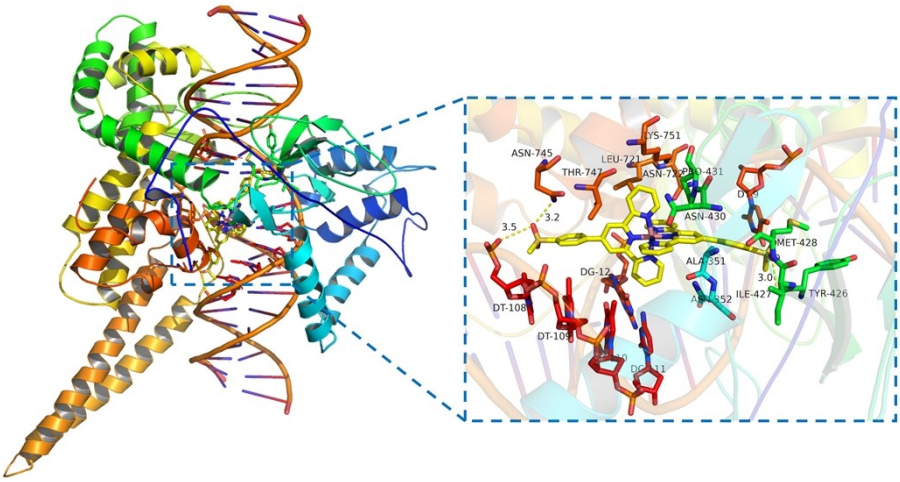

Figure S32. Binding modes of complex **3** with Top I (PDB ID: 1T8I).

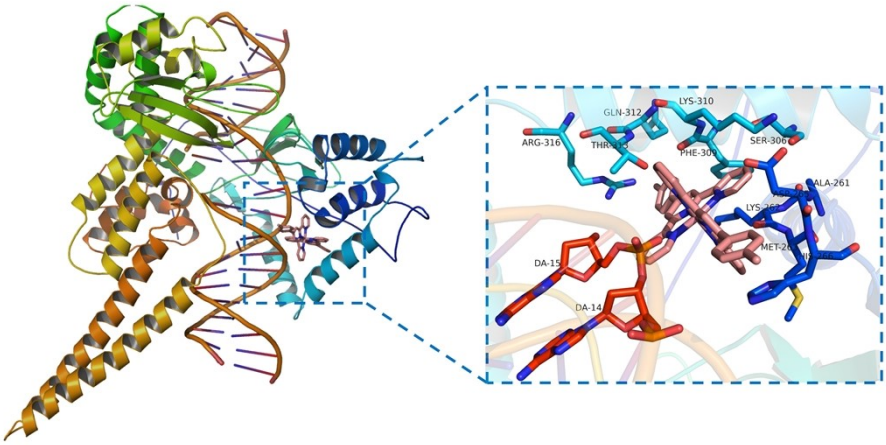

Figure S33. Binding modes of complex **4** with Top I (PDB ID: 1T8I).

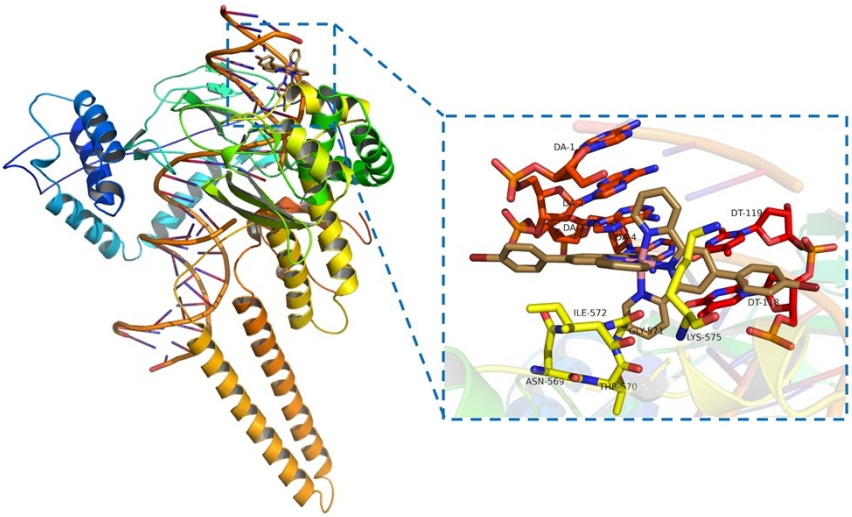

Figure S34. Binding modes of complex **5** with Top I (PDB ID: 1T8I).

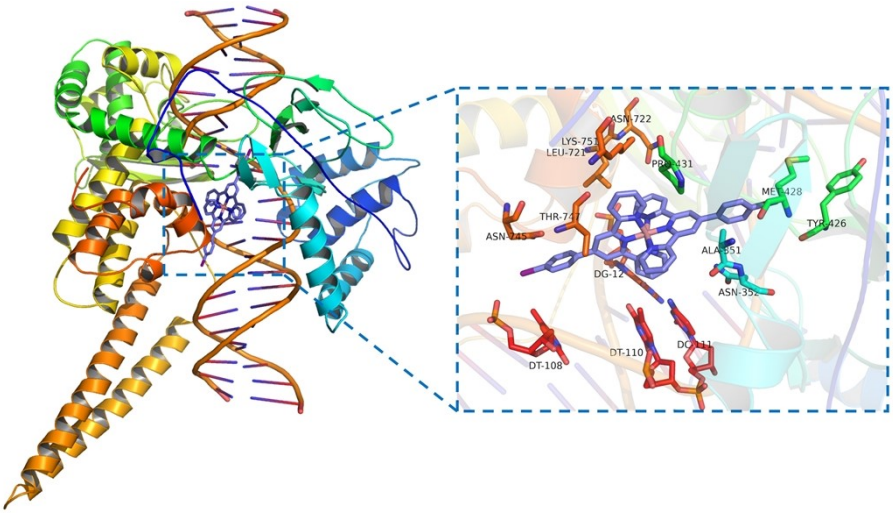

Figure S35. Binding modes of complex **6** with Top I (PDB ID: 1T8I).

Table S1. Selected geometric parameters of the complexes.

Complex	**1**	**2**	**3**	**4**	**5**	**6**
Empirical formula	$C_{42}H_{30}Cl_2CoN_6$	$C_{44}H_{34}Cl_2CoN_6O_2$	$C_{44}H_{34}Cl_2CoN_6O_4S_2$	$C_{44}H_{34}Cl_2CoN_6$	$C_{42}H_{28}Br_2Cl_2CoN_6$	$C_{42}H_{31}Cl_2CoI_2N_6O_3$
Formula weight	748.55	808.6	904.72	776.6	906.35	1051.36
Temperature	296(2) K	296(2) K	296(2) K	296(2) K	296(2)	298 K
Crystal system	Triclinic	Triclinic	Triclinic	Tetragonal	Monoclinic	Monoclinic
Space group	$P\bar{1}$	$P\bar{1}$	$P\bar{1}$	$I4_1/a$	$C2/c$	$C2/c$
a (Å)	10.6413(7)	10.725(2)	11.5679(4)	11.4940(5)	24.649(4)	16.5178(9)
b (Å)	11.5087(6)	11.525(2)	14.3215(5)	11.4940(5)	9.6058(17)	14.7305(9)
c (Å)	19.8685(11)	19.766(4)	15.9903(6)	35.533(4)	23.874(3)	37.360(2)
α (°)	97.120(4)	106.16(3)	73.603(3)	90	90°	90
β (°)	95.761(5)	94.85(3).	76.313(3)	90	118.391(19)°	92.850(5)
γ (°)	111.838(6)	97.02(3)	77.065(3)	90	90°	90
Volume (Å^3)	2212.7(2)	2311.0(9)	2433.90(16)	4694.3(6)	4973.0(16)	9079.1(9)
Z	2	2	2	4	4	8
Density (calculated) (Mg/m^3)	1.124	1.162	1.235	1.099	1.211	1.538
Absorption coefficient (mm^{-1})	0.541	0.526	0.592	0.512	2.090	1.898
F (000)	770	834	930	1604	1812	4128
Crystal size (mm^3)	0.15 × 0.11 × 0.1	0.11 × 0.07 × 0.06	0.1 × 0.07 × 0.07	0.1 × 0.07 × 0.05	0.14 × 0.12 × 0.12	0.2 × 0.13 × 0.12
θ_{max}, θ_{min} (°)	3.053, 29.494	2.877, 29.525	2.756, 29.419°	3.398, 29.488°	1.878, 29.328°	3.249, 29.420°
Index range h, k, l	-13<=h<=9 -14<=k<=13 -27<=l<=26	-13<=h<=10 -14<=k<=13 -27<=l<=25	-15<=h<=15 -19<=k<=15 -21<=l<=21	-9<=h<=15 -9<=k<=15 -48<=l<=46	-32<=h<=28 -13<=k<=12 -20<=l<=32	-22<=h<=20 -20<=k<=19 -48<=l<=39
Reflections collected/unique	20797	24031	27736	12160	12236	25664
Data/restraints/parameters	10239 / 0 / 460	10726 / 50 / 518	11431 / 0 / 534	2882 / 0 / 127	5700 / 159 / 277	10781 / 0 / 481
Goodness-of-fit on F^2	1.036	1.06	1.037	1.058	0.980	1.024
Final R indices [$I > 2\sigma(I)$]	R1 = 0.0672 wR2 = 0.2052	R1 = 0.0647 wR2 = 0.1942	R1 = 0.0442 wR2 = 0.1289	R1 = 0.0695 wR2 = 0.2129	R1 = 0.0793 wR2 = 0.2111	R1 = 0.0638 wR2 = 0.1677
R indices (all data)	R1 = 0.0825 wR2 = 0.2232	R1 = 0.0812 wR2 = 0.2147	R1 = 0.0550 wR2 = 0.1376	R1 = 0.0945 wR2 = 0.2407	R1 = 0.1635 wR2 = 0.2595	R1 = 0.0819 wR2 = 0.1851
Largest diff. peak and hole (e Å^{-3})	0.559 and -1.062	0.855 and -1.029	1.067 and -0.515	0.915 and -0.296	0.467 and -0.468	1.382 and -1.646

Table S2. Distribution coefficients of complexes **1-9**

	Absorbance			$C_{organic}$ (μg/mL)			Log $D_{7.4}$
Complex	1	2	3	1	2	3	Average
1	0.950	0.948	0.946	10.07	10.05	10.02	0.612
2	0.637	0.638	0.639	10.08	10.09	10.11	0.623
3	0.837	0.838	0.839	10.05	10.06	10.07	0.615
4	0.970	0.970	0.969	10.17	10.17	10.16	0.639
5	0.728	0.727	0.725	10.21	10.20	10.17	0.645
6	0.774	0.773	0.773	10.14	10.13	10.13	0.632
7	1.151	1.150	1.152	9.96	9.95	9.97	0.593
8	0.764	0.762	.0761	10.07	10.05	10.03	0.613
9	0.767	0.766	0.765	10.06	10.05	10.04	0.613

Table S3. Hydrogen bond interactions for compounds **2**, **3**.

Compound	Receptor	Bonds formed	Bond distance (Å)
2	B-DNA (1BNA)	O…H–N(DA-17)	2.2
	B-DNA (1BNA)	O…H–N(DG-16)	2.8
	survivin (3UIH)	O…H–N(ASN-119)	2.2
	survivin (3UIH)	O…H–N(LYS-115)	2.3
	DNA-topoisomerase I (1T8I)	O–H…O (DLU-267)	3.0
	DNA-topoisomerase I (1T8I)	O…H–N( )	2.8
3	B-DNA (1BNA)	O–H…O2 (DA-17)	2.6
	B-DNA (1BNA)	O2…H–N(DA-17)	2.5
	B-DNA (1BNA)	O–H…O1 (DG-16)	2.1
	survivin (3UIH)	O–H…O1 (LYS-112)	2.8
	survivin (3UIH)	O–H…O2 (LYS-112)	3.0
	survivin (3UIH)	O–H…O3 (SER-20)	3.0
	survivin (3UIH)	O–H…O4 (SER-20)	3.6
	survivin (3UIH)	O…H–N(LYS-23)	2.1
	DNA-topoisomerase I (1T8I)	O–H…O2 (DT-108)	3.5
	DNA-topoisomerase I (1T8I)	O–H…O2 (ANS-745)	3.2
	DNA-topoisomerase I (1T8I)	O–H…O4 (TYR-426)	3.0
	DNA-topoisomerase I (1T8I)	O…H–N(MET-428)	3.0

Synthesis of complexes 1-9

4′-(substituted phenyl)-terpyridine ligands $\mathbf{L^1}$-$\mathbf{L^9}$ were synthesized from each of the 4-substituted benzaldehyde and 2-acetylpyridine according to the literature. Complexes **1-9** were synthesized by the reaction of $\mathbf{L^1}$-$\mathbf{L^9}$ with $CoCl_2 \cdot 6H_2O$ added in stoichiometric amounts, respectively, in a methanol-CH_2Cl_2 solution.

$[Co(L^1)_2]Cl_2$ (1). A solution of $CoCl_2 \cdot 6H_2O$ (0.12 g, 0.48 mmol) in ethanol (10 mL) was added dropwise to a 10 mL dichloromethane solution of $\mathbf{L^1}$ (0.10 g, 0.32 mmol) in a 50 mL flask, and stirred for 8 h at ambient temperature. A brown solid (0.075 g, 75% yield based on $\mathbf{L^1}$) was obtained upon filtration of the solution and washed with dichloromethane and dried in a desiccator. Anal. Calcd for $C_{42}H_{30}N_6CoCl_2 \cdot 3.75\ CH_2Cl_2 \cdot 2.1H_2O$: C, 49.73; H, 3.80; N, 7.60%. Found: C, 49.25; H, 3.36; N, 8.16 %. IR (KBr disc) (cm^{-1}) (s = strong, m = medium, w = weak): 3057 (m, $\upsilon_{C\text{-}H}$), 1644 (m, n-pyridyl-H), 1602 (s), 1544 (m, n-pyridyl-H), 1474 (s, *n*-pyridyl-H), 1414 (s), 1246 (s, $\beta_{C\text{-}H}$), 1162 (s, $\beta_{C\text{-}H}$), 1017 (s, $\beta_{C\text{-}H}$), 895 (m, $\gamma_{C\text{-}H}$), 759 (m, $\gamma_{C\text{-}H}$), 768 (s, $\gamma_{C\text{-}H}$), 732 (m, $\gamma_{C\text{-}H}$), 690 (m, $\gamma_{C\text{-}H}$), 657 (m), 623 (m).

$[Co(L^2)_2]Cl_2$ (2). A solution of $CoCl_2 \cdot 6H_2O$ (0.11 g, 0.44 mmol) in ethanol (10 mL) was added dropwise to a solution of $\mathbf{L^2}$ (0.10 g, 0.29 mmol) dissolved in dichloromethane (10 mL) in a 50 mL flask and stirred for 8 h at ambient temperature. A brown solid (0.067 g, 67% yield based on $\mathbf{L^2}$) was obtained upon filtration of the solution and washed with dichloromethane and dried in a desiccator. Anal. Calcd for $C_{44}H_{34}N_6O_2CoCl_2 \cdot 2.1CH_2Cl_2$: C, 56.10; H, 3.90; N, 8.51%. Found: C, 55.72; H, 4.12; N, 8.70 %. IR (KBr disc) (cm^{-1}): 3057 (m, $\upsilon_{C\text{-}H}$), 2839 (w, $\upsilon_{C\text{-}H}$), 1599 (s, *n*-pyridyl-H), 1547 (w, *n*-pyridyl-H), 1519 (s, *n*-pyridyl-H), 1473 (s, $\upsilon_{C=C}$), 1434 (m, $\upsilon_{C=C}$), 1407 (m, $\upsilon_{C=C}$), 1366 (w, $\upsilon_{C=C}$), 1239 (s, $\upsilon_{Ar\text{-}O\text{-}Me}$), 1183 (s, $\upsilon_{Ar\text{-}O\text{-}Me}$), 1126 (w, $\beta_{C\text{-}H}$), 1068 (m, $\beta_{C\text{-}H}$), 1019 (s, $\beta_{C\text{-}H}$) 890 (w, $\gamma_{C\text{-}H}$), 839 (s, $\gamma_{C\text{-}H}$), 790 (s, $\gamma_{C\text{-}H}$), 748 (m, $\gamma_{C\text{-}H}$), 727 (s, $\gamma_{C\text{-}H}$), 657 (m), 639 (s).

$[Co(L^3)_2]Cl_2$ (3). A solution of $CoCl_2 \cdot 6H_2O$ (0.09 g, 0.38 mmol) in ethanol (10 mL) was added dropwise to a solution of $\mathbf{L^3}$ (0.10 g, 0.29 mmol) dissolved in dichloromethane (10 mL) in a 50 mL flask and stirred for 8 h at ambient temperature. A brown solid (0.071 g, 71% yield based on $\mathbf{L^3}$) was obtained upon filtration of the solution and washed with dichloromethane and dried in a desiccator. Anal. Calcd for $C_{44}H_{34}N_6O_4S_2CoCl_2 \cdot CH_2Cl_2$: C, 54.61; H, 3.66; N, 8.49%. Found: C, 54.44; H, 3.20; N, 8.65 %. IR (KBr disc) (cm^{-1}): 3059 (w, $\upsilon_{C\text{-}H}$), 2985 (w, $\upsilon_{C\text{-}H}$), 2905 (w, $\upsilon_{C\text{-}H}$), 1613 (s, *n*-pyridyl-H), 1548 (m, *n*-pyridyl-H), 1473 (s, $\upsilon_{C=C}$), 1428 (s, $\upsilon_{C=C}$), 1391 (s, $\upsilon_{C=C}$), 1289 (s, υ_{SO2}), 1249 (w, υ_{SO2}), 1141 (s, υ_{SO2}), 1093 (m, $\beta_{C\text{-}H}$), 1012 (m, $\beta_{C\text{-}H}$), 983 (s, $\gamma_{C\text{-}H}$), 900 (w, $\gamma_{C\text{-}H}$), 838 (m, $\gamma_{C\text{-}H}$), 796 (m, $\upsilon_{S\text{-}O}$), 774 (s, $\gamma_{C\text{-}H}$), 732 (s, $\gamma_{C\text{-}H}$), 676 (m), 657 (m), 636 (m).

$[Co(L^4)_2]Cl_2$ (4). A solution of $CoCl_2 \cdot 6H_2O$ (0.11 g, 0.46 mmol) in ethanol (10 mL) was added dropwise to a solution of $\mathbf{L^4}$ (0.10 g, 0.31 mmol) dissolved in dichloromethane (10 mL) in a 50 mL flask and stirred for 8 h at ambient temperature. A brown solid (0.065 g, 65% yield based on $\mathbf{L^4}$)

was obtained upon filtration of the solution and washed with dichloromethane and dried in a desiccator. IR (KBr disc) (cm^{-1}): 3057 (w, $\upsilon_{C\text{-}H}$), 3022 (w, $\upsilon_{C\text{-}H}$), 2918 (w, $\upsilon_{C\text{-}H}$), 2864 (w, $\upsilon_{C\text{-}H}$), 1602 (s, *n*-pyridyl-H), 1547 (m, *n*-pyridyl-H), 1473 (s, $\upsilon_{C=C}$), 1428 (m, $\upsilon_{C=C}$), 1403 (s, $\upsilon_{C=C}$), 1251 (m, $\beta_{C\text{-}H}$), 1013 (m, $\beta_{C\text{-}H}$), 894 (w, $\gamma_{C\text{-}H}$), 826 (m, $\gamma_{C\text{-}H}$), 792(s, $\gamma_{C\text{-}H}$), 730 (s, $\gamma_{C\text{-}H}$), 688 (w), 657 (m).

$[Co(L^5)_2]Cl_2$ (5). A solution of $CoCl_2{\cdot}6H_2O$ (0.09 g, 0.39 mmol) in ethanol (10 mL) was added dropwise to a solution of **L^5** (0.10 g, 0.26 mmol) dissolved in dichloromethane (10 mL) in a 50 mL flask and stirred for 8 h at ambient temperature. A brown solid (0.072 g, 72% yield based on **L^5**) was obtained upon filtration of the solution and washed with dichloromethane and dried in a desiccator. Anal. Calcd for $C_{42}H_{28}Br_2N_6CoCl_2{\cdot}2.2CH_2Cl_2{\cdot}0.2H_2O$: C, 48.40; H, 3.01; N, 7.66%. Found: C, 47.96; H, 2.52; N, 8.06 %. IR (KBr disc) (cm^{-1}): 3057 (w, $\upsilon_{C\text{-}H}$), 1599 (s, *n*-pyridyl-H), 1545 (m, *n*-pyridyl-H), 1473 (s, $\upsilon_{C=C}$), 1427 (m, $\upsilon_{C=C}$), 1390 (m, $\upsilon_{C=C}$), 1250 (m, $\beta_{C\text{-}H}$), 1161 (w, $\beta_{C\text{-}H}$), 1060 (m, $\beta_{C\text{-}H}$), 1001 (s, $\beta_{C\text{-}H}$), 893 (w, $\gamma_{C\text{-}H}$), 827 (s, $\gamma_{C\text{-}H}$), 792 (s, $\gamma_{C\text{-}H}$), 729 (m, $\gamma_{C\text{-}H}$), 658 (m, $\upsilon_{C\text{-}Br}$), 639 (m).

$[Co(L^6)_2]Cl_2$ (6). A solution of $CoCl_2{\cdot}6H_2O$ (0.08 g, 0.34 mmol) in ethanol (10 mL) was added dropwise to a solution of **L^6** (0.10 g, 0.23 mmol) dissolved in dichloromethane (10 mL) in a 50 mL flask and stirred for 8 h at ambient temperature. A brown solid (0.069 g, 69% yield based on **L^6**) was obtained upon filtration of the solution and washed with dichloromethane and dried in a desiccator. Anal. Calcd for $C_{42}H_{28}I_2N_6CoCl_2{\cdot}2.1CH_2Cl_2{\cdot}1.8H_2O$: C, 43.73; H, 2.98; N, 6.94%. Found: C, 43.49; H, 2.97; N, 7.27 %. IR (KBr disc) (cm^{-1}): 3059 (w, $\upsilon_{C\text{-}H}$), 1599 (s, *n*-pyridyl-H), 1546 (m, *n*-pyridyl-H), 1473 (s, $\upsilon_{C=C}$), 1429 (m, $\upsilon_{C=C}$), 1392 (m, $\upsilon_{C=C}$), 1250 (m, $\beta_{C\text{-}H}$), 1158 (w, $\beta_{C\text{-}H}$), 1065 (m, $\beta_{C\text{-}H}$), 1005 (s, $\beta_{C\text{-}H}$), 893 (w, $\gamma_{C\text{-}H}$), 831 (s, $\gamma_{C\text{-}H}$), 793 (s, $\gamma_{C\text{-}H}$), 730 (m, $\gamma_{C\text{-}H}$), 657 (m), 639 (m), 585 (w, $\upsilon_{C\text{-}I}$).

$[Co(L^7)_2]Cl_2$ (7). A solution of $CoCl_2{\cdot}6H_2O$ (0.09 g, 0.39 mmol) in ethanol (10 mL) was added dropwise to a solution of **L^7** (0.10 g, 0.26 mmol) dissolved in dichloromethane (10 mL) in a 50 mL flask and stirred for 8 h at ambient temperature. A brown solid (0.066 g, 66% yield based on **L^7**) was obtained upon filtration of the solution and washed with dichloromethane and dried in a desiccator. Anal. IR (KBr disc) (cm^{-1}): 3059 (w, $\upsilon_{C\text{-}H}$), 1608 (w, $\delta_{C\text{-}H}$), 1599 (s, *n*-pyridyl-H), 1545 (m, *n*-pyridyl-H), 1472 (s, $\upsilon_{C=C}$), 1428 (m, $\upsilon_{C=C}$), 1392 (m, $\upsilon_{C=C}$), 1250 (m, $\beta_{C\text{-}H}$), 1160 (w, $\beta_{C\text{-}H}$), 1065 (m, $\beta_{C\text{-}H}$), 1005 (s, $\beta_{C\text{-}H}$), 894 (w, $\gamma_{C\text{-}H}$), 830 (s, $\gamma_{C\text{-}H}$), 792(s, $\gamma_{C\text{-}H}$), 730 (m, $\gamma_{C\text{-}H}$), 700 (w), 657 (m), 638(m).

$[Co(L^8)_2]Cl_2$ (8). A solution of $CoCl_2{\cdot}6H_2O$ (0.10 g, 0.44 mmol) in ethanol (10 mL) was added dropwise to a solution of **L^8** (0.10 g, 0.29 mmol) dissolved in dichloromethane (10 mL) in a 50 mL flask and stirred for 8 h at ambient temperature. A brown solid (0.072 g, 72% yield based on **L^8**) was obtained upon filtration of the solution and washed with dichloromethane and dried in a desiccator. Anal. Calcd for $C_{42}H_{28}Cl_2N_6CoCl_2{\cdot}2.8CH_2Cl_2{\cdot}2.6H_2O$: C, 48.82; H, 3.54; N, 7.62%.

Found: C, 48.44; H, 3.05; N, 8.17 %. IR (KBr disc) (cm^{-1}): 3059 (w, υ_{C-H}), 1600 (s, *n*-pyridyl-H), 1547 (m, *n*-pyridyl-H), 1473 (s, $\upsilon_{C=C}$), 1430 (m, $\upsilon_{C=C}$), 1396 (m, $\upsilon_{C=C}$), 1249 (m, β_{C-H}), 1158 (w, β_{C-H}), 1092 (m, β_{C-H}), 1011 (s, β_{C-H}), 897 (w, γ_{C-H}), 835 (s, γ_{C-H}), 793 (s, γ_{C-H}), 730 (m, υ_{C-Cl}), 657 (m), 639 (m).

$[Co(L^9)_2]Cl_2$ (9). A solution of $CoCl_2 \cdot 6H_2O$ (0.1 g, 0.46 mmol) in ethanol (10 mL) was added dropwise to a solution of $\mathbf{L^9}$ (0.10 g, 0.31 mmol) dissolved in dichloromethane (10 mL) in a 50 mL flask and stirred for 8 h at ambient temperature. A brown solid (0.070 g, 70% yield based on $\mathbf{L^9}$) was obtained upon filtration of the solution and washed with dichloromethane and dried in a desiccator. Anal. Calcd for $C_{42}H_{28}F_2N_6CoCl_2 \cdot 2.1CH_2Cl_2 \cdot 2.4H_2O$: C,52.64; H, 3.71; N, 8.35%. Found: C, 52.46; H, 3.45; N, 8.78%. IR (KBr disc) (cm^{-1}): 3069 (w, υ_{C-H}), 1599 (s, *n*-pyridyl-H), 1548 (m, *n*-pyridyl-H), 1518 (m, $\upsilon_{C=C}$), 1473 (s, $\upsilon_{C=C}$), 1433 (m, $\upsilon_{C=C}$), 1400 (m, $\upsilon_{C=C}$), 1231 (s, υ_{C-F}), 1167 (s, β_{C-H}), 1013 (m, β_{C-H}), 897 (w, γ_{C-H}), 841 (s, γ_{C-H}), 793 (s, γ_{C-H}), 730 (m, γ_{C-H}), 657 (m), 639 (m) and 572 (m).