

## Supplementary Information

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## Synthesis

### 1. Platinum complexes

***Cis-cis-trans-Pt<sup>IV</sup>(Cl)<sub>2</sub>(NH<sub>3</sub>)<sub>2</sub>(OH)<sub>2</sub> (oxoplatin)***: Cisplatin (100 mg, 0.33 mmol) was dissolved in 1.5 mL of deionized water. H<sub>2</sub>O<sub>2</sub> (4 mL; 30% in water) was added drop-wise and the mixture was heated at 60°C overnight in the dark. The solution was then cooled to room temperature and placed in a refrigerator for 1 h. A light yellow powder (or crystals under conditions of very slow cooling overnight) is obtained. The solid was collected by filtration using 0.8 μM isopore<sup>TM</sup> membrane filters (Millipore), rinsed with cold water and dried under vacuum. The product (60 mg, 54%) was characterized by ESI-MS and IR spectroscopy and the data correspond to those reported in ref. S1.

**ESI-MS**: positive mode: 300 [M-Cl]<sup>+</sup> and 356.9 [M+Na]<sup>+</sup>

**FTIR**: 3460 and 540 cm<sup>-1</sup> (O-H and Pt-OH bond stretchings)

***Cis-cis-trans-Pt<sup>IV</sup>(Cl)<sub>2</sub>(NH<sub>3</sub>)<sub>2</sub>(OH)(OOC-CH<sub>2</sub>-COOH) (3)***: Oxoplatin (60 mg, 0.18 mmol) was dissolved in dry DMSO (5 mL) and succinic anhydride (18 mg, 0.18 mmol) was added. The reaction mixture was stirred under N<sub>2</sub> in the dark overnight. The solution containing some insoluble material was filtered a first time using a PTFE membrane filter, which was then washed with cold acetone. To the filtrate was added a further aliquot of cold acetone (V<sub>total</sub> = 500 mL). The filtrate was then left in an ice cold bath in the dark for 2 h. A very thin suspension formed. This was collected by filtration using another PTFE membrane filter, washed with cold acetone and dried under vacuum. The product (54 mg, 69%) was characterized by ESI-MS (high resolution), <sup>1</sup>H NMR spectroscopy, IR spectroscopy, and elemental analysis. The characterization data correspond to those reported in ref. S2:

**ESI-MS:**

Positive mode: 416.97 [M-OH]<sup>+</sup>, 434.98 [M+H]<sup>+</sup>, 456.97 [M+Na]<sup>+</sup>

Negative mode: 432.97 [M-H]<sup>-</sup>, 468.94 [M+Cl]<sup>-</sup>

**<sup>1</sup>H-NMR** (DMSO-*d*<sub>6</sub>, 300 K, 400 MHz): 2.3 ppm (4H, m, -CH<sub>2</sub>), 5.8 ppm (6H, m, NH<sub>3</sub>).

Note: In D<sub>2</sub>O, the NH<sub>3</sub> signals are not visible. However, the signals from the coordinated succinic acid moiety are better differentiated than in DMSO-*d*<sub>6</sub> (two triplets each integrating for 2H at 2.38 and 2.58 ppm).

**Elemental analysis**: Calcd for C<sub>4</sub>H<sub>12</sub>Cl<sub>2</sub>N<sub>2</sub>O<sub>5</sub>Pt: C 11.07, H 2.79, Cl 16.33, N 6.45; found: C 11.83, H 2.88, Cl 15.62, N 6.35.

**FT-IR**: 3460, 1700, 1640, 540 cm<sup>-1</sup>

**Note**: IR absorption features corresponding to the presumed O-H bond stretching mode (3460 cm<sup>-1</sup>) are maximal for oxoplatin, intermediate for complex **3**, and absent for cisplatin. The same order is observed for the Pt-OH bond stretching features (540 cm<sup>-1</sup>). For complex **3**, peaks at 1640 and 1700 cm<sup>-1</sup>, characteristic of coordinated and free carboxylic acid groups, respectively, are observed.

## **2. Texaphyrins:**

**1 = MGd\***

**1<sup>ODMT</sup> = MGd(OH)(ODMT)\***

**1<sup>ODMT</sup><sub>NH2</sub> = MGd(NH<sub>2</sub>)(ODMT)\***

**1<sup>NH2</sup><sub>NH2</sub> = MGd(NH<sub>2</sub>)(NH<sub>2</sub>)**

**4 = MGd(3)**

**5 = MGd(3)<sub>2</sub>**

**6 = MGd(succinic acid)**

\* known compounds whose synthesis are already published.<sup>S3</sup>

**1<sup>NH2</sup><sub>NH2</sub>**: To a round bottom flask containing triphenylphosphine (685 mg, 2.6 mmol) was added phthalimide (384.5 mg, 2.6 mmol) and **1** (500 mg, 0.287 mmol) in one batch, both of which starting materials were previously dried overnight under vacuum. To this mixture was added 100 mL of freshly distilled CH<sub>2</sub>Cl<sub>2</sub> (dried over CaH<sub>2</sub>). The resulting green solution was cooled over ice for about 15 minutes under N<sub>2</sub>. Following this, diisopropylazocarboxylate (514 μL, 2.6 mmol) was added drop-wise. The reaction mixture was kept over ice for 2-3 hours and allowed to warm slowly to ambient temperature. The solvent was removed under reduced pressure. To the resulting residue, was added 30 mL of methanol, 10 mL of acetonitrile (to increase the solubility) and 27 mL of methylamine (40% in water). After 7 hours of stirring at ambient temperature, N<sub>2</sub> was bubbled through the reaction mixture to remove excess methylamine. The volatiles were then removed under reduced pressure and the resulting solids were resuspended in 20 mL of acetonitrile and 80-100 mL of an aqueous 0.1 M ammonium acetate/1% acetic acid solution. The resulting solution was loaded on a C-18 column and purified by chromatography using an increasing gradient of acetonitrile/0.1 M aqueous ammonium acetate + 1% acetic acid while monitoring by HPLC (RT = 6.9 min). The product was loaded on a new C-18 column, desalted by rinsing with HPLC grade submicron filtered water, eluting with methanol, and drying under reduced pressure. This gave a dark green powder (140 mg, 24%).

Notes: The published protocol for **1<sup>ODMT</sup><sub>NH2</sub>** (see ref S3) recommends extracting the products with chloroform after deprotection by methylamine. However, in the case of **1<sup>NH2</sup><sub>NH2</sub>** this protocol is not effective because the product remains in the aqueous layer. Therefore, the crude material was loaded immediately onto the C18 column. Before being coupled with **3**, **1<sup>NH2</sup><sub>NH2</sub>** was solubilized in a mixture of acetonitrile and 0.1 M aqueous KNO<sub>3</sub> in order to exchange the acetate ligands for nitrate. The resulting solution was loaded on a new C18 column and as described above, desalted with water, eluted off the column using methanol, and then dried under reduced pressure.

### 3. Conjugates TEX-Pt(IV):

**4<sub>NO3</sub> = MGd(OH)(3):** EDC•HCl (40 mg, 0.21 mmol) and N-hydroxysuccinimide NHS (24 mg, 0.21 mmol) were dissolved in HPLC submicron filtered grade water (4 mL). Complex **3** (22 mg, 50  $\mu$  mol) as a suspension in water (2 mL) was added to the mixture (termed “EDC•HCl + NHS”) and left stirring for 30 minutes. Precursor **1**<sup>ODMT<sub>NH2</sub></sup> (60 mg, 42  $\mu$  mol, HPLC RT = 11.4 min) in CH<sub>3</sub>CN (5 mL) was added drop-wise to the previous solution and the reaction mixture was kept in the dark for 20 h at 40°C. The progress of the reaction was monitored by HPLC (a new peak is formed that is characterized by a RT = 9 min). Following this period, KNO<sub>3</sub> (50 mL of a 0.1 M aqueous solution) was added and the resulting solution was loaded onto a C18 column and subject to elution with increasing gradient of acetonitrile in 0.1 M aqueous KNO<sub>3</sub>. The isolated fraction was loaded onto a new C18 column, desalted with water and eluted with pure methanol. The solvent was removed under vacuum to give the product as a dark green powder (26.4 mg, 40%). The non-platinated compound, **MGd(OH)(NH<sub>2</sub>)** (the DMT group was deprotected by HCl), is isolated during the purification. This latter species was used in another coupling reaction (see below).

Note: During this coupling, a trace of **6** (ca. 5%; RT = 9.99 min) is formed, as inferred from the HPLC analysis.

**Elemental analysis:** Calcd for C<sub>52</sub>H<sub>77</sub>Cl<sub>2</sub>GdN<sub>10</sub>O<sub>19</sub>Pt: C 39.79, H 4.95, Cl 4.52, N 8.92; found: C 39.07, H 4.97, Cl 4.17, N 8.90.

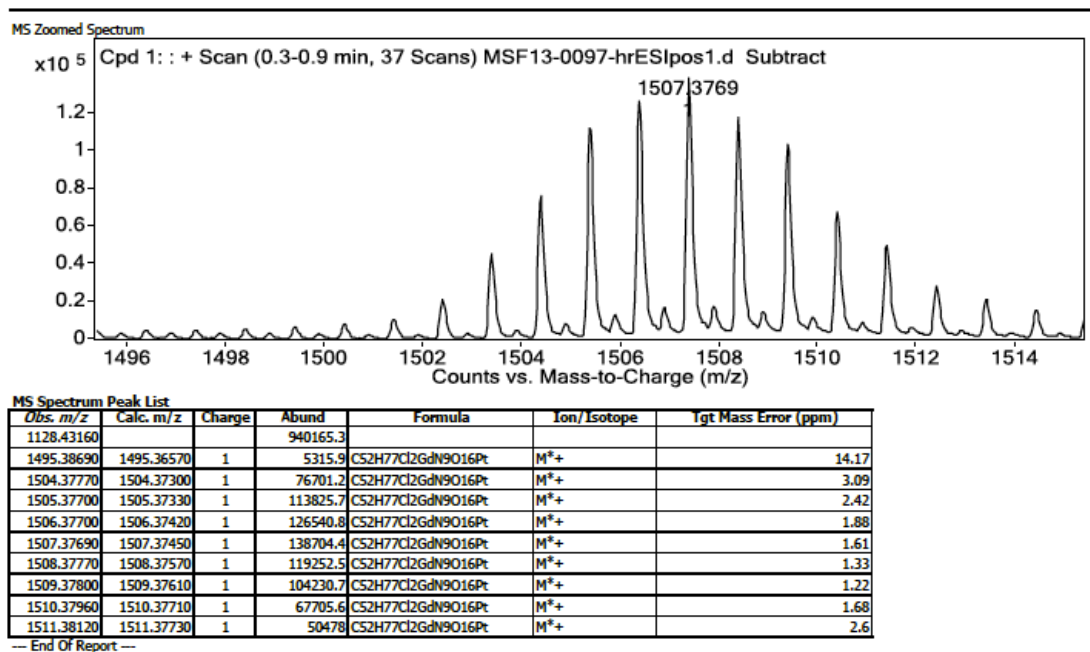


Figure S2: High-resolution ESI-MS spectrum of **4** recorded from an aqueous sample.

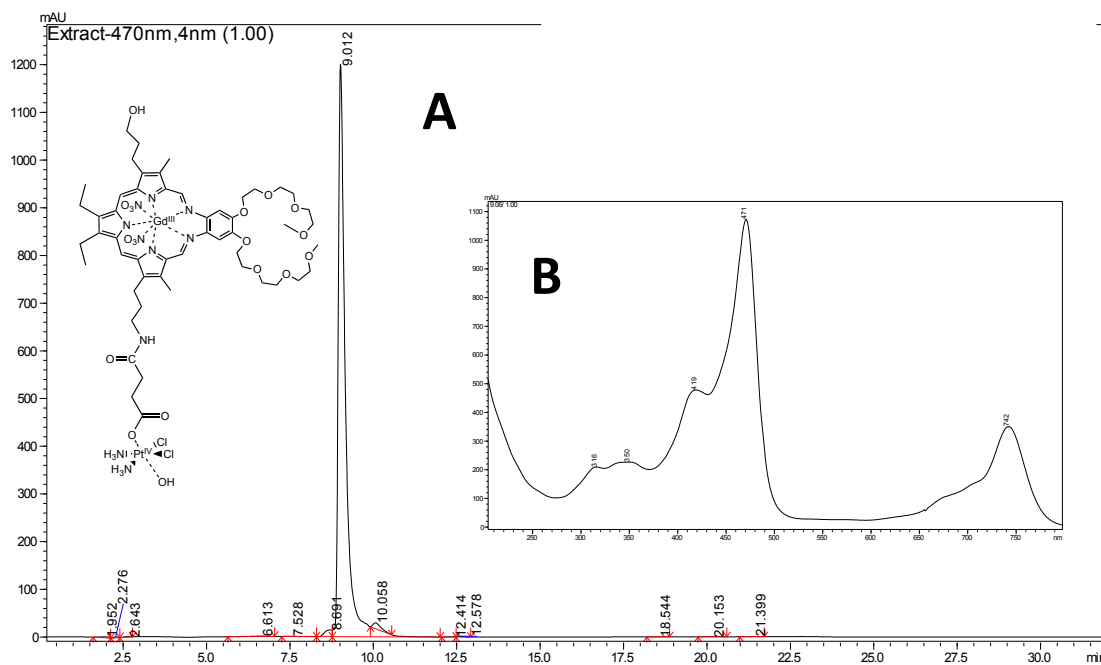
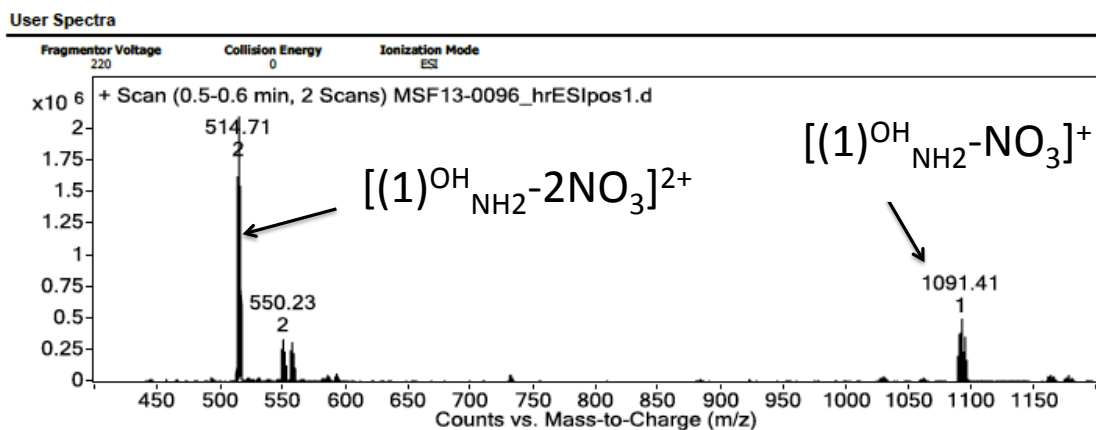


Figure S3: RP-HPLC chromatogram monitoring at 470 nm (A) and UV-vis spectrum (B) of conjugate **4** studied in water.

Note: Sometimes it proved difficult to drive the reaction to completion. However, this was generally not problematic since the non-platinated species  $1^{\text{OH}}_{\text{NH}_2}$  (the DMT group was removed by HCl) is relatively easy to separate using a C18 column. Once isolated, the product was analyzed by high resolution ESI-MS; the data follow.

**A**



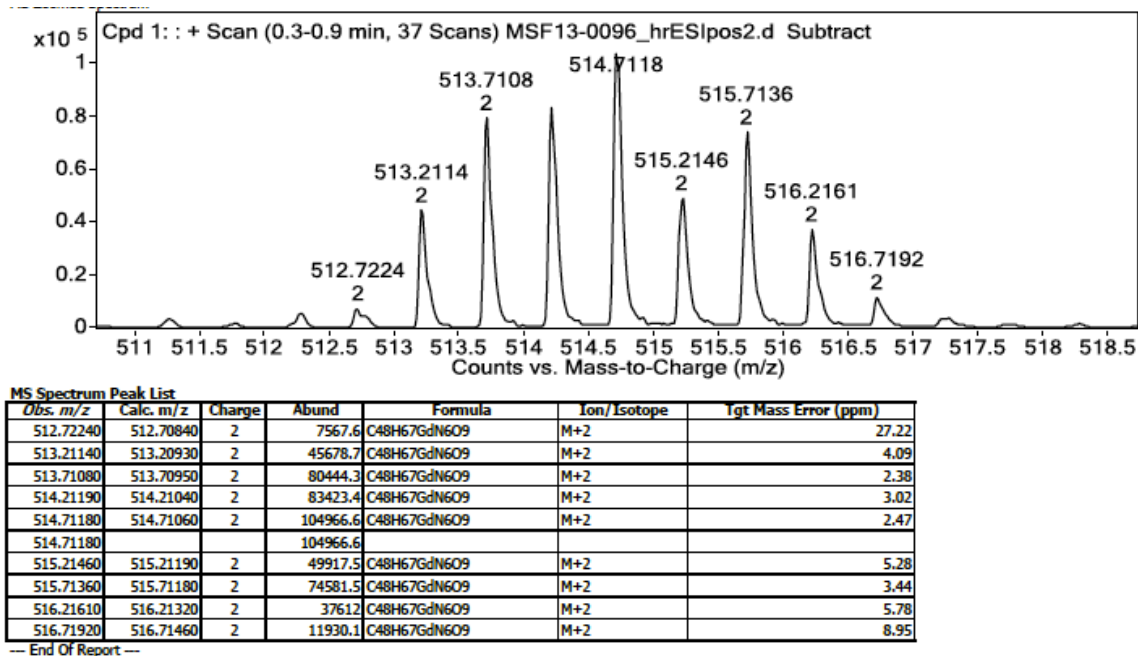
**B**

Figure S4: High-resolution ESI-MS spectra of deprotected species **1(OH)(NH<sub>2</sub>)** after isolation using a C18 column. A: Entire spectrum; B: magnified view of the major peak with theoretical isotopic relative abundance also shown.

**(6) MGd(OH)(succinic acid):** This compound can be obtained by either reducing the platinum(IV) center within the conjugate **4** (light, sodium ascorbate or glutathione) or from the reaction between **1**<sup>ODMT</sup><sub>NH<sub>2</sub> and succinic acid. In this latter instance, **1**<sup>ODMT</sup><sub>NH<sub>2</sub> (20 mg, 13.7 μmol) in acetonitrile (50 mL) was added slowly and drop-wise into a solution containing succinic acid (1.6 g, 13.7 mmol), EDC•HCl (2.6 g, 13.7 mmol) and NHS (1.53 g, 13.7 mmol) in HPLC submicron filtered grade water (150 mL). The reaction was stirred overnight under N<sub>2</sub>. The reaction progress was checked by TLC (silica gel plates; 80/20 CH<sub>2</sub>Cl<sub>2</sub>/MeOH, eluent) with R<sub>f</sub> **1**<sup>ODMT</sup><sub>NH<sub>2</sub> = 0 and R<sub>f</sub> **6**<sup>ODMT</sup> = 0.57. The solution was loaded on a C18 column and the product was purified using an increasing gradient of acetonitrile in an aqueous solution of 0.1 M ammonium acetate + 1% acetic acid. The protected intermediate (**6**<sup>ODMT</sup>) was desalted using submicron filtered HPLC grade water, eluted with methanol and dried under reduced pressure. To deprotect the DMT group, **6**<sup>ODMT</sup> was dissolved in 2 mL of dichloromethane and 1.5 mL of acetic acid were added. The solution was stirred for 3 h and checked by TLC (silica gel plates; 80/20 CH<sub>2</sub>Cl<sub>2</sub>/MeOH, eluent). The R<sub>f</sub> of **6** = 0.34. The product was purified on a C18 column as above (yield: 6.6 mg, 40%).</sub></sub></sub>

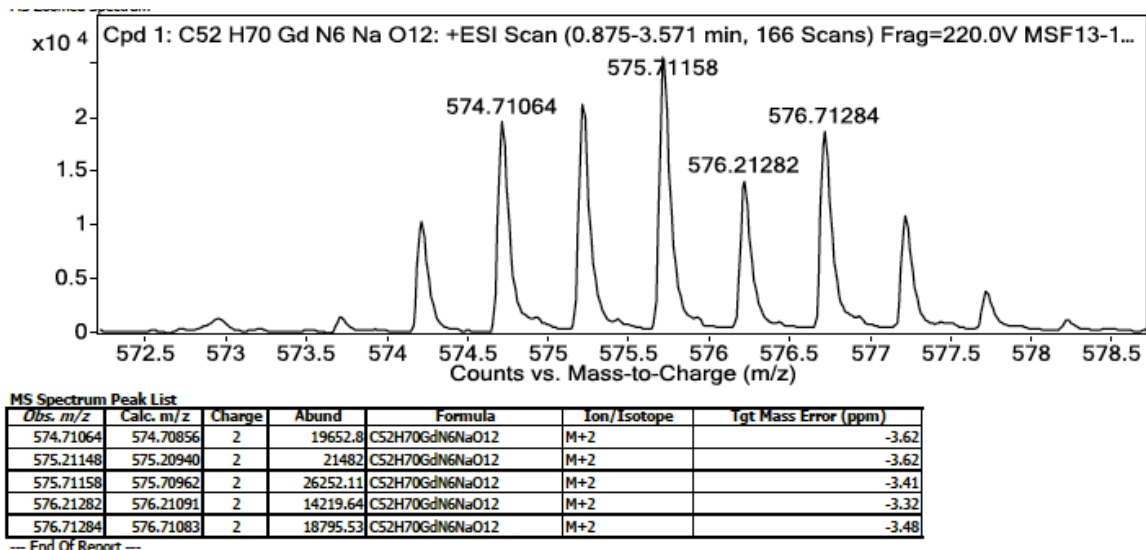


Figure S5: High-resolution spectrum of **6** (zoomed on the major peak).

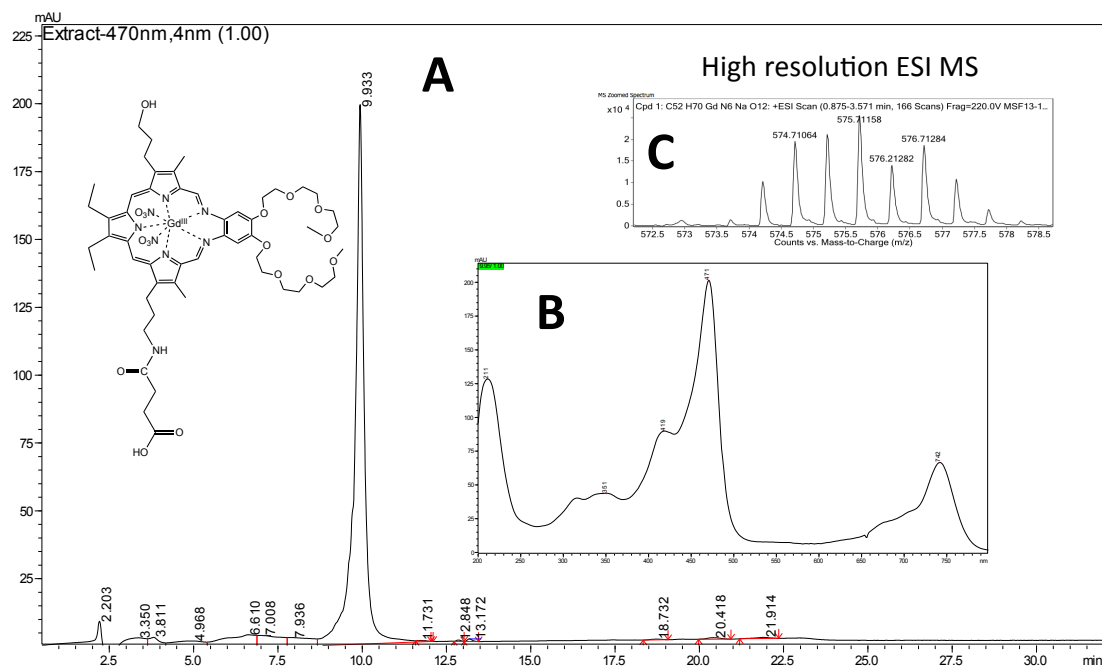
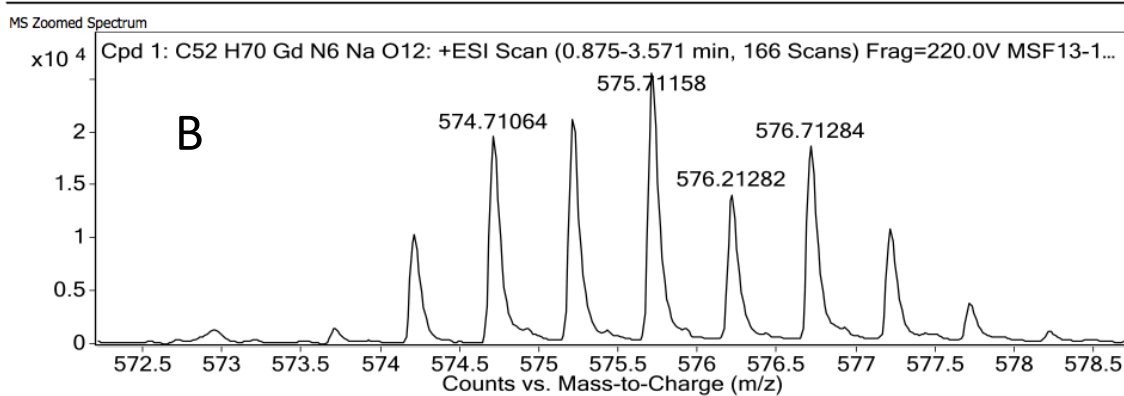
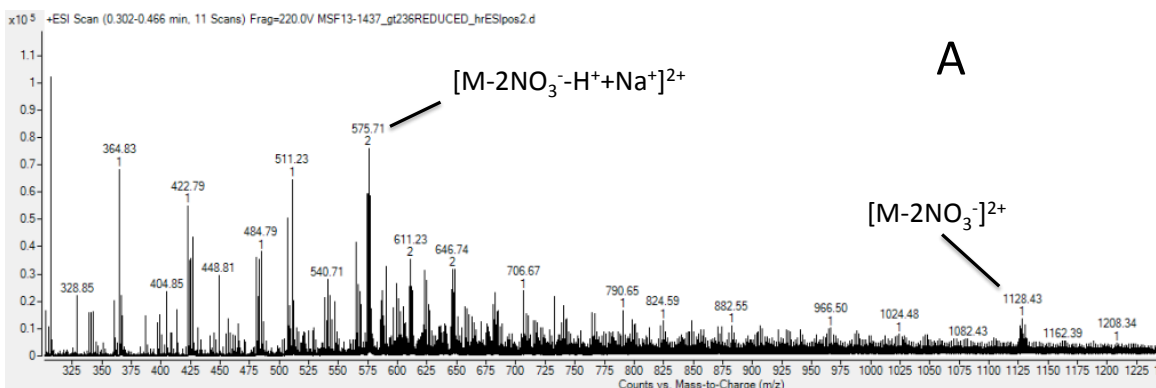


Figure S6: RP-HPLC chromatogram monitored at 470 nm (A) and UV-vis spectrum (B) of **6** recorded in water.



MS Spectrum Peak List						
Obs. m/z	Calc. m/z	Charge	Abund	Formula	Ion/Isotope	Tgt Mass Error (ppm)
574.71064	574.70856	2	19652.8	C52H70GdN6NaO12	M+2	-3.62
575.21148	575.20940	2	21482	C52H70GdN6NaO12	M+2	-3.62
575.71158	575.70962	2	26252.11	C52H70GdN6NaO12	M+2	-3.41
576.21282	576.21091	2	14219.64	C52H70GdN6NaO12	M+2	-3.32
576.71284	576.71083	2	18795.53	C52H70GdN6NaO12	M+2	-3.48

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Figure S7: High resolution ESI-MS spectrum of **6** obtained after exposing **4** to laboratory light (2 days) (A); magnified view of the most intense peak (B).

Note: the same results were observed after reaction of **4** with sodium ascorbate or glutathione.

**5**<sub>NO<sub>3</sub></sub> = **MGd(3)**<sub>2</sub>: EDC•HCl (14.5 mg, 76 μmol) and N-hydroxysuccinimide NHS (8.74 mg, 0.21 mmol) were dissolved in submicron filtered HPLC grade water (8 mL). Complex **3** (33 mg, 76 μmol) as a suspension in water (2 mL) was added to the “EDC•HCl + NHS” solution and left stirring for 30 minutes. Precursor **1**<sup>NH<sub>2</sub></sup><sub>NH<sub>2</sub></sub> (34.5 mg, 30 μmol, RT = 6.9 min) in CH<sub>3</sub>CN (5 mL) was added drop-wise to the previous solution and the reaction mixture was kept in the dark for 20 hours. The progress of the reaction was checked by HPLC. Two new peaks appear at RT = 7.7 and 8.7 min as the reaction is allowed to run. The first peak (7.7 min) is the mono-platinated compound **MGd(3)(NH<sub>2</sub>)** and the second one (8.7 min) is the desired bis-platinated product (**5**). After 20 h, EDC•HCl and NHS (76 μmol of each) were added in water. After 3 days, there is still a trace of starting material (2%). The mono- and bisplatinated compounds are likewise



present in similar quantities (as inferred from HPLC analysis). The solution was diluted with 0.1 M aqueous  $\text{KNO}_3$  and loaded onto a C18 column. The two conjugates were purified and isolated using an increasing gradient of acetonitrile in 0.1 M aqueous  $\text{KNO}_3$ . Fractions were monitored by HPLC, desalted using a new C18 column and submicron filtered HPLC grade water, eluted with methanol and dried under reduced pressure. This gave **5** as dark green powder. The yield was 12 mg (20%).

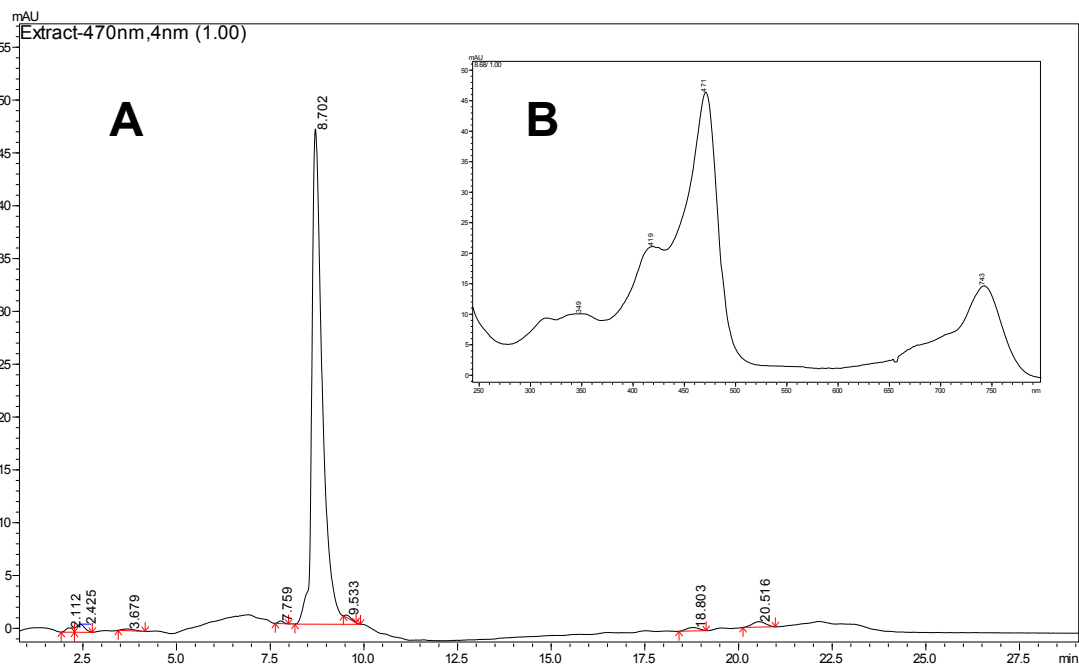
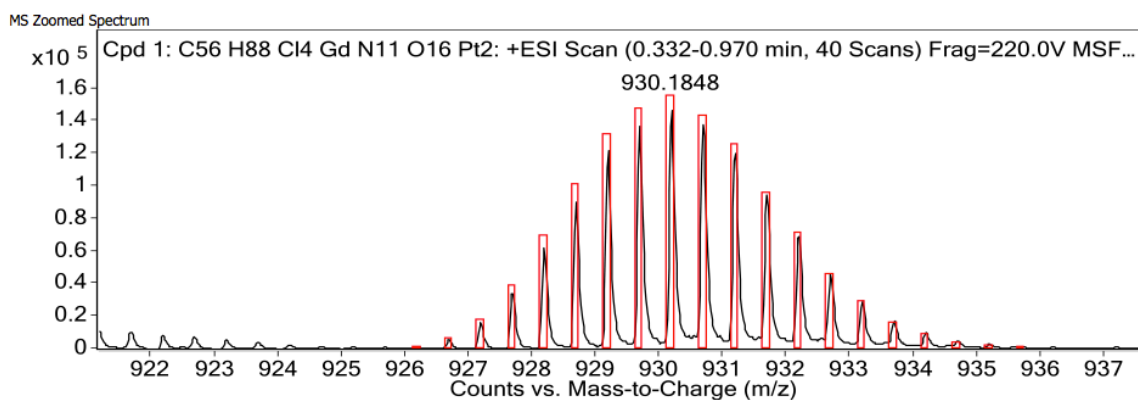


Figure S8: RP-HPLC chromatogram monitored at 470 nm (A) and UV-vis spectrum (B) of conjugate **5** in water.



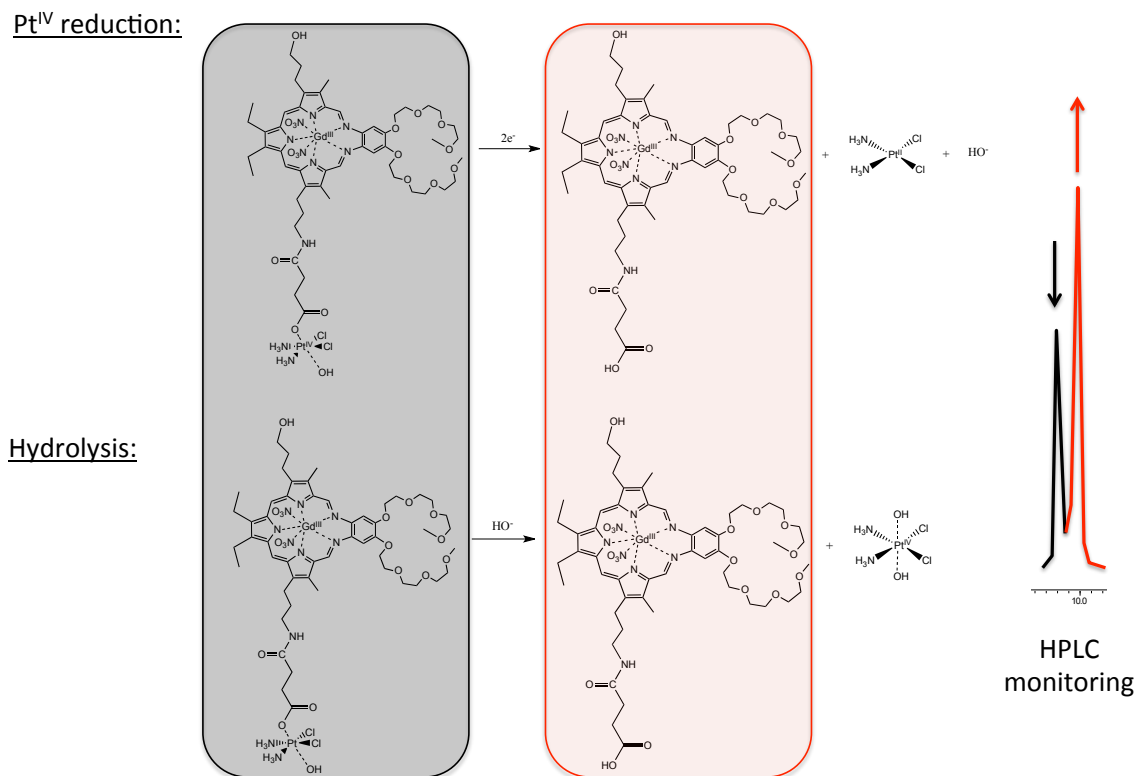
ms spectrum peak list

Obs. m/z	Calc. m/z	Charge	Abund	Formula	Ion/Isotope	Tgt Mass Error (ppm)
928.18350	928.18270	2	62484.17	C56H88Cl4GdN11O16Pt2	M+2	-0.83
928.68400	928.68300	2	92583.37	C56H88Cl4GdN11O16Pt2	M+2	-1.04
929.18420	929.18310	2	121981.53	C56H88Cl4GdN11O16Pt2	M+2	-1.12
929.68450	929.68340	2	139164.12	C56H88Cl4GdN11O16Pt2	M+2	-1.24
930.18480	930.18360	2	147072.3	C56H88Cl4GdN11O16Pt2	M+2	-1.31
930.68470	930.68380	2	138793.38	C56H88Cl4GdN11O16Pt2	M+2	-0.89
931.18510	931.18400	2	121406.43	C56H88Cl4GdN11O16Pt2	M+2	-1.23
931.68480	931.68430	2	94558.21	C56H88Cl4GdN11O16Pt2	M+2	-0.52
932.18500	932.18440	2	70213.45	C56H88Cl4GdN11O16Pt2	M+2	-0.65

Figure S9: High resolution ESI-MS showing an enhancement of the most intense peaks corresponding to **5**. Red boxes represent theoretical isotopic relative abundances.

#### **Stability of the conjugate (4)**

**Hydrolysis and light-induced reduction of 4:** For the hydrolysis studies, reactions were carried in the dark by following the changes in the spectral features as a function of time in aqueous media. For the light-induced release studies, solutions of **3** or **4** contained in glass vials were exposed to sunlight in the laboratory behind a double-paned window (Viracon<sup>®</sup>, VE1-85), filtering off about 75% of the UV light. The same experiments were also carried out using a fluorescent tube Hg 25W (light source in chemical fume hood).



Scheme S2: Formation of **6** (red frame) upon reduction (peak size increasing) or hydrolysis (peak size decreasing) of **4** (black frame) monitored by RP-HPLC.

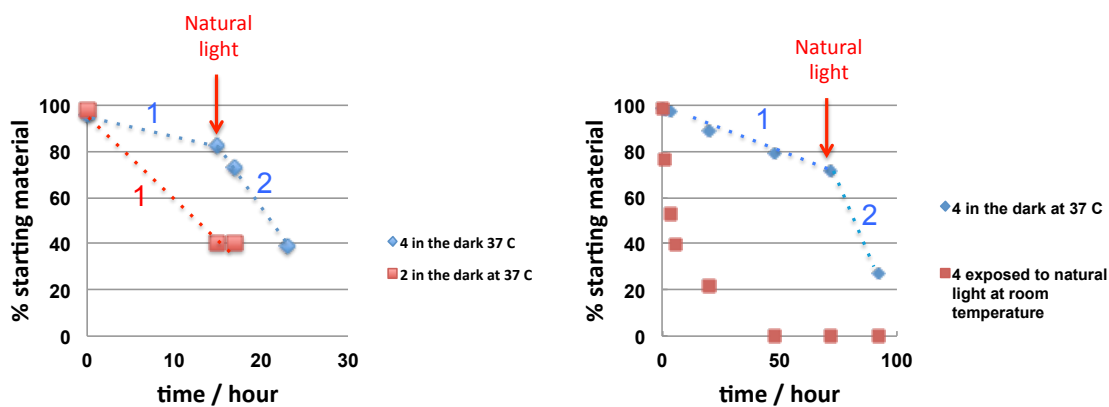


Figure S10: left: Comparison of the rate of hydrolysis for the known platinum(II)-texaphyrin conjugate **2** (cisTEX, red squares) compared to that of **4** at 37 C (blue rhombi) in phosphate buffer saline solution (pH = 7.5, 6 mM phosphate, 100 mM NaCl); Right: Reduction rate of **4** in the dark at 37 C (blue rhombi) compared to (**4**) exposed to laboratory light at room temperature (red squares) in phosphate buffer saline (pH = 7.5, 6 mM phosphate, 100 mM NaCl). The designation 1 indicates the hydrolysis phase 1 (absence of light) while the designator 2 indicates the phase corresponding to subsequent light exposure.

In order to identify the reduced platinum complex, the solution was loaded onto a C18 column to separate the platinum complex from the texaphyrin moiety. The green fraction was found to contain the succinic-functionalized texaphyrin **6**, as identified by RP-HPLC and HR ESI-MS analysis (Figures S6-S7). The first fraction collected, containing the platinum complex, revealed a peak eluting at 3 min analogous to those observed for cisplatin and for **3** after being reduced (cf. Figure S11).

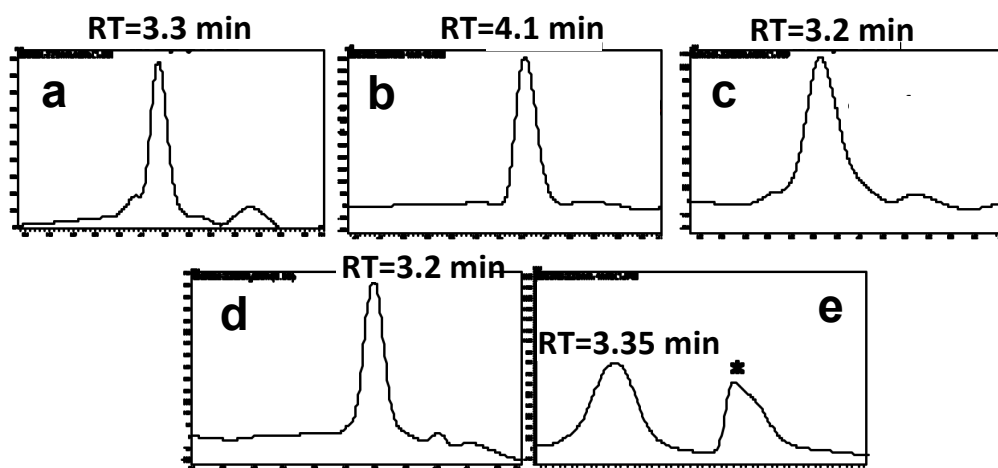


Figure S11: RP-HPLC traces of cisplatin (a), **3** in the dark (b), **3** after being exposed 48 hours to ambient light (c), **4** after 48 hours light exposure (d), **4** after 1 hour reaction with sodium ascorbate (5 equiv.) \* Peak corresponding to sodium ascorbate.

### Photo-reactivity of **3**:

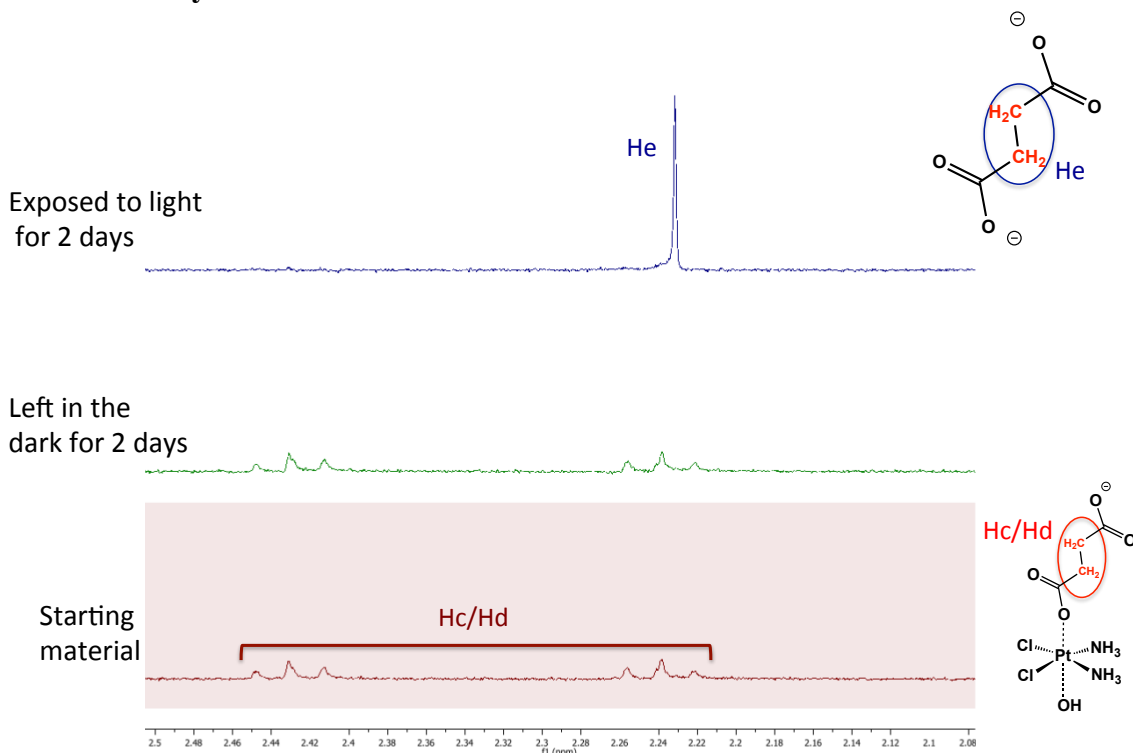


Figure S12: <sup>1</sup>H NMR (D<sub>2</sub>O PBS solution pH = 7.5, 300 K, 400 MHz) spectra of **3** recorded before and after exposure to laboratory light, showing the release of succinate anion (He).

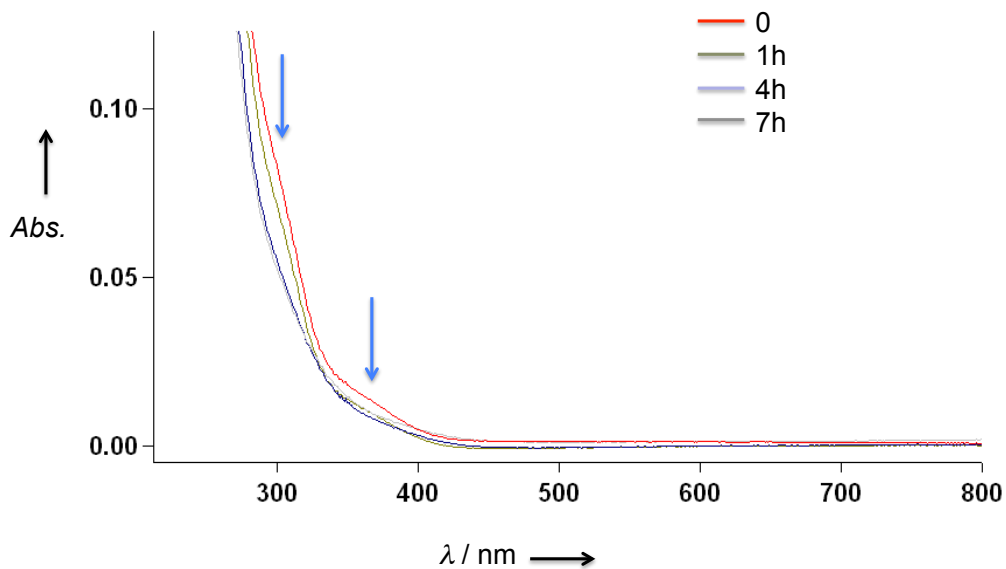


Figure S13: UV-visible spectra of **3** (in PBS solution, pH = 7.5, concentration = 1.6 × 10<sup>-4</sup> M) before (red line) and after laboratory light exposure. The evolution observed (decrease in absorbance between 290 and 390 nm when Pt(IV) is reduced) is consistent with previously published results.<sup>S10</sup>

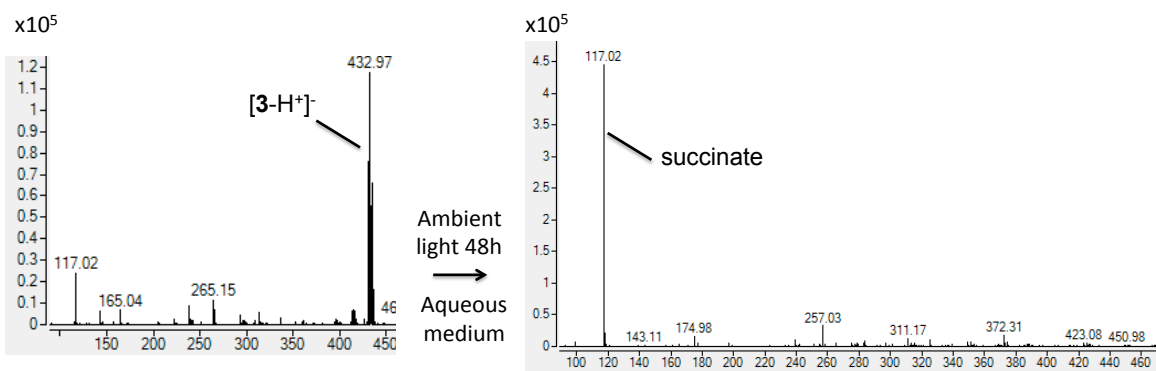


Figure S14: ESI-MS (negative mode, PBS solution) spectra of **3** before (left) and after 48h light exposure (right) showing the release of succinate anions after light exposure.

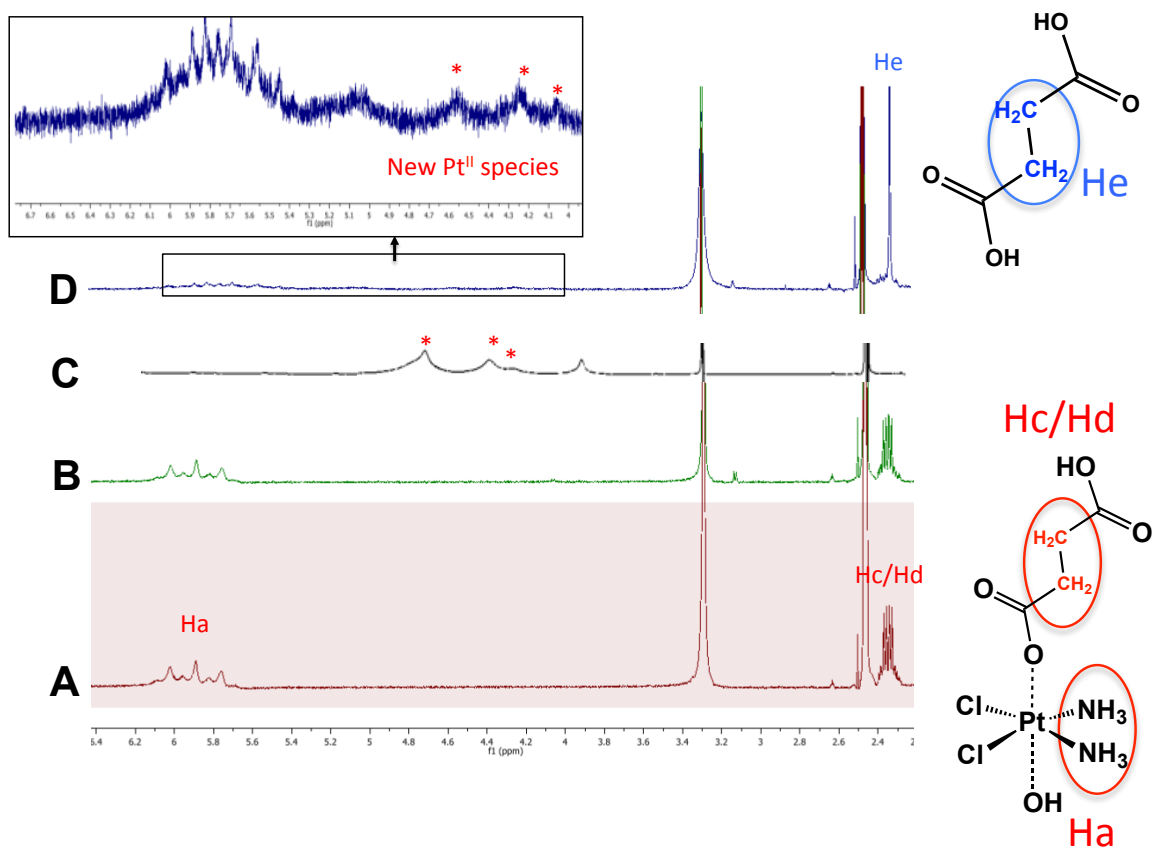


Figure S15:  $^1\text{H}$  NMR (DMSO, 300 K, 400 MHz) spectra of **3** before letting sit (A) in the dark for 22 h (B) and (D) after being exposed for 48h to ambient light, showing the release of succinic acid (He) and formation of new species (red stars). The spectrum C corresponds to cisplatin in DMSO.

Note: It is known that DMSO interacts with Pt<sup>II</sup>,<sup>S9</sup> a finding that explains the NMR spectral profiles observed in (C) and (D). Support for this expected interaction was provided by subjecting this solution to ESI-MS analysis; see below.

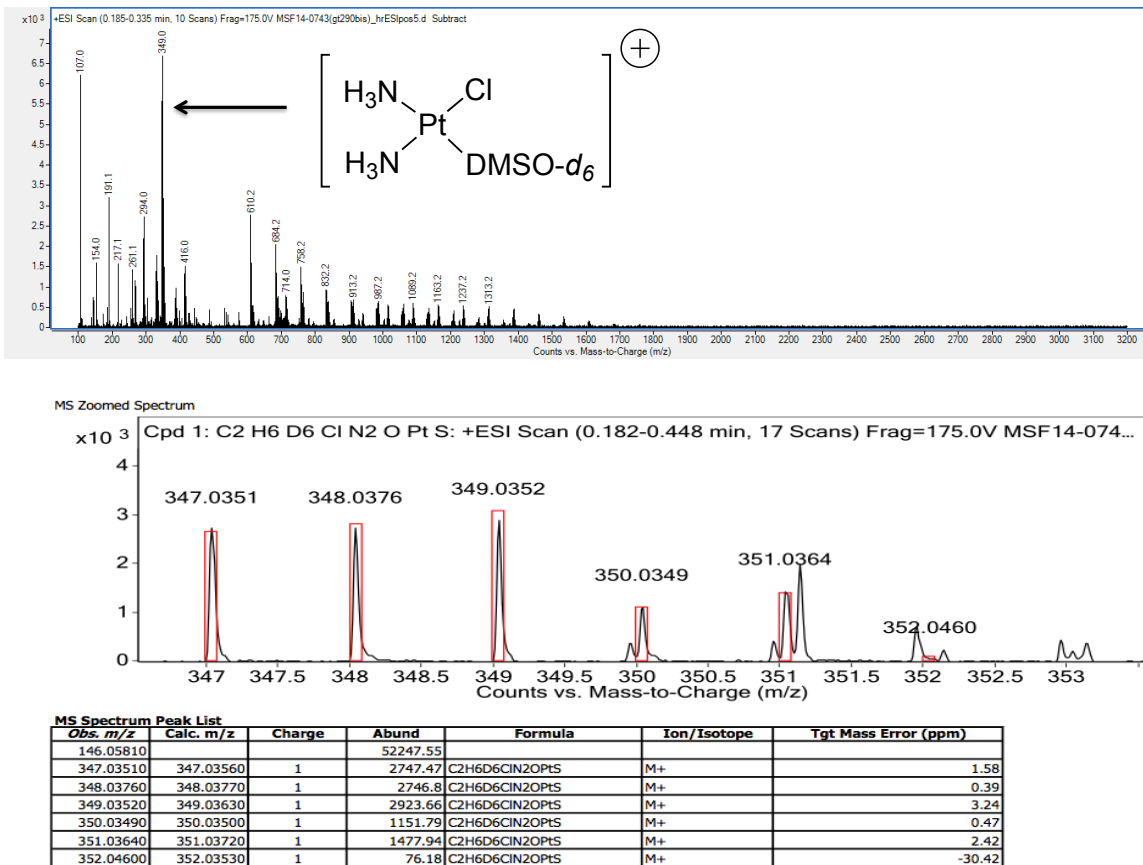


Figure S16: High resolution ESI-MS spectrum of **3** in DMSO-*d*<sub>6</sub> (solution used for NMR studies) after being exposed for 2 days to ambient light.

**Interaction between 5'-GMP and the photo-induced reduction product of **3**:**

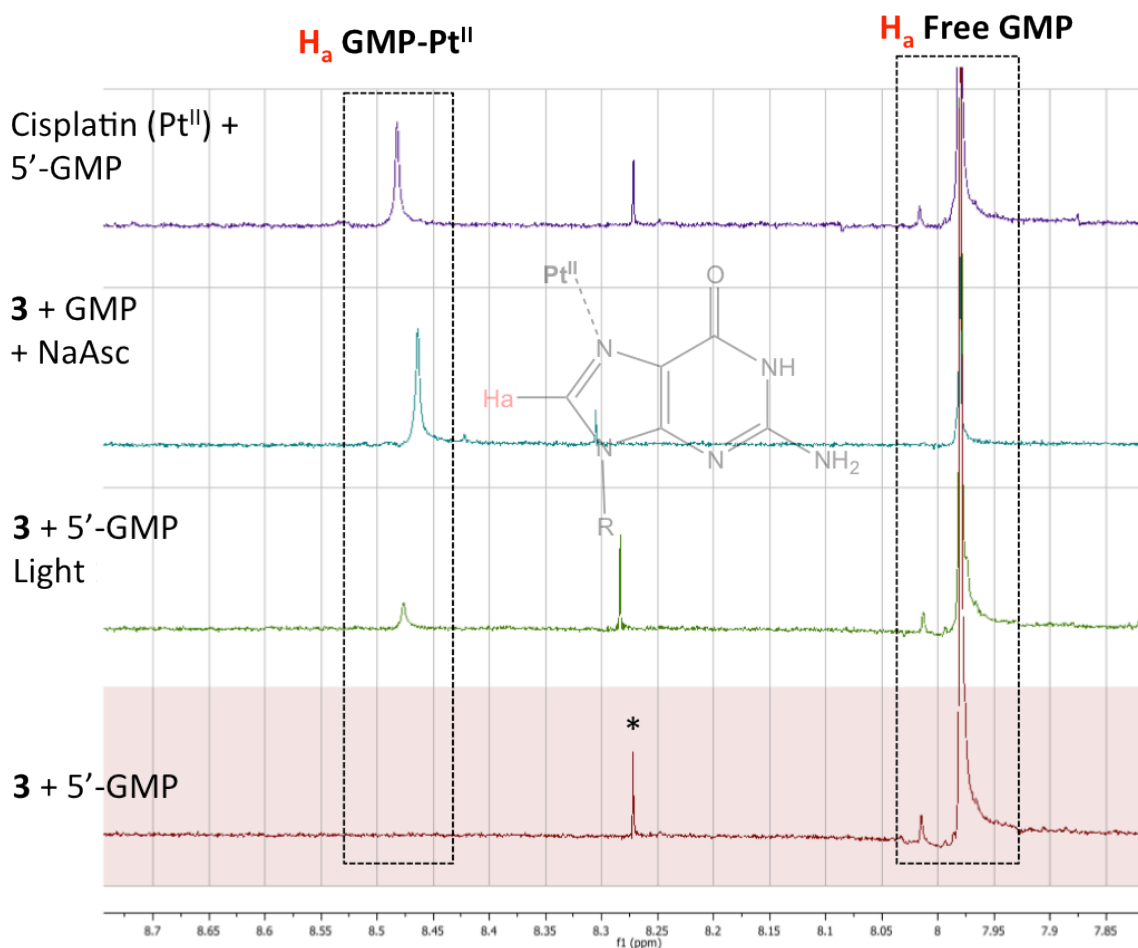


Figure S17: <sup>1</sup>H NMR spectra recorded in D<sub>2</sub>O (pH = 7), 300 K, 400 MHz as obtained after exposure of the product obtained by reduction of **3** (either using laboratory light (filtered sunlight) for two days or sodium ascorbate (5 equiv.)) to 5'-GMP for 2 additional days. As a reference, cisplatin was exposed to 2 equivalents of 5'-GMP for 2 days; this forms the adduct (5'-GMP)<sub>2</sub>Pt<sup>II</sup>(NH<sub>3</sub>)<sub>2</sub>.

\* = impurity.



### **Platinum-DNA interactions:**

Salmon sperm DNA (1.125 mL of 500  $\mu\text{g}$  DNA/mL in Tris-EDTA buffer) was incubated at 37 °C in the dark or exposed to light with platinum complexes (in solution in water; approximately 1 platinum/75 nucleotides as the final ratio) in the absence or presence of glutathione (GSH; solution in 20 mM EDTA). 200  $\mu\text{L}$  aliquots were removed and added immediately to 40  $\mu\text{L}$  of a 10 M aqueous ammonium acetate solution. DNA in samples was precipitated by adding 0.8 mL of absolute ethanol prechilled at -20°C. The samples were left in an ice bath for 1 h and centrifuged at 14000 rpm for 4 minutes. The supernatant was removed carefully and small pellets obtained in this way were dissolved in 50  $\mu\text{L}$  of TRIS-EDTA buffer overnight at room temperature. Platinum content was determined by FAAS (model AA300/GTA-96; Varian Instruments, Victoria, Australia) using conditions described previously.<sup>S7,S8</sup> Samples were diluted with HCl when the initial Pt concentration was too high. DNA concentrations were determined using a Nanodrop ND-1000 spectrophotometer.

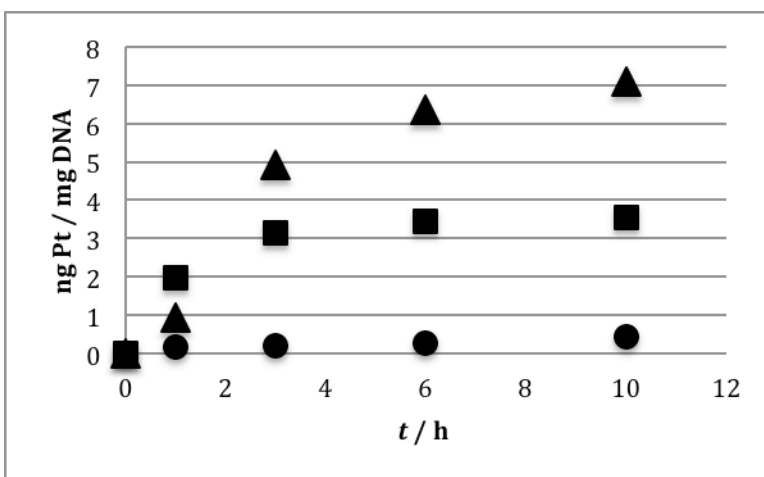


Figure S18: Quantification by FAAS (Pt) and by nanodrop (DNA) of the number of Pt-DNA adducts formed after reaction of **4** with DNA in the dark (black circles) or exposed to laboratory light (black squares). Cisplatin (triangle) was used as a reference.

### In vitro tests:

The proliferation of exponential phase cultures of A2780 and 2780CP cells was assessed by tetrazolium dye reduction.<sup>56</sup> In brief, tumor cells were seeded in 96-well microliter plates at 500 (A2780) and 1000 (2780CP) cells/well, respectively, and allowed to adhere overnight in RPMI 1640 medium supplemented with 2 mM L-glutamine, 10% heat inactivated fetal bovine serum, and antibiotics (200 U/cm<sup>3</sup> penicillin and 200  $\mu$ g/cm<sup>3</sup> streptomycin). After 4 days, the tetrazolium dye, 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT, Sigma Chemical) was added to each well, the plates incubated at 37°C for 4 hours, whereupon the medium was removed, the formazan product dissolved in DMSO (50-100  $\mu$ L) and absorbance values at 560-650 nm were measured using a microplate reader (Molecular Devices, Sunnyvale, CA). Absorbance values were corrected for background and then normalized to wells containing untreated cells to allow plate-to-plate comparisons. The growth inhibition data were fitted to a sigmoidal dose-response curve to generate IC<sub>50</sub>, which is the drug concentration inhibiting cell growth by 50%. The IC<sub>50</sub> is presented as mean  $\pm$  standard deviation.

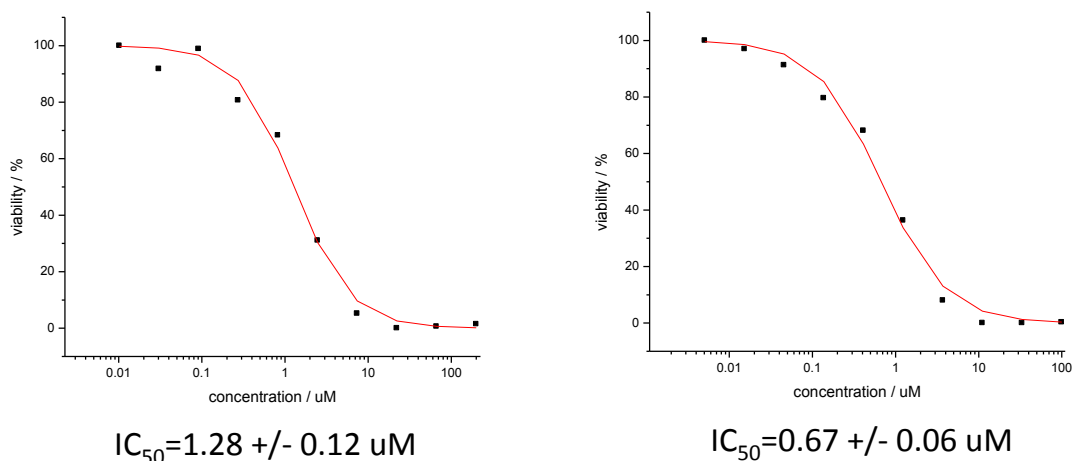
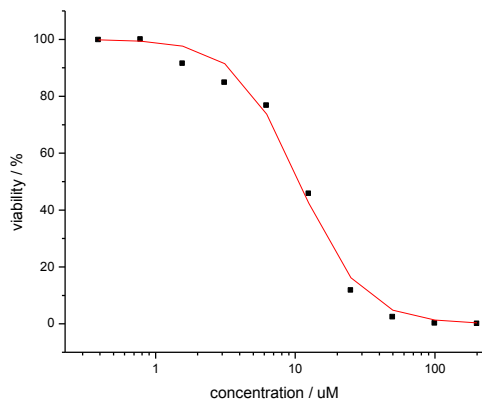
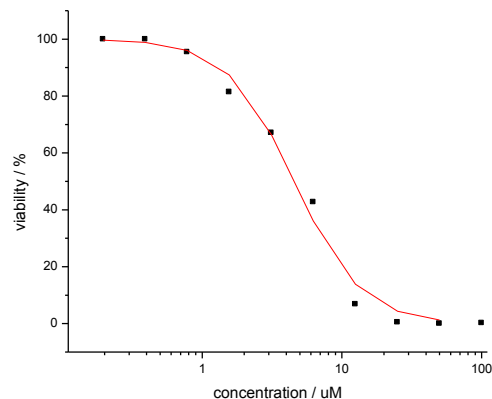


Figure S19: Determination of the half maximal inhibitory concentrations (IC<sub>50</sub> in  $\mu$ M, logarithmic scale) for the conjugates **4** (left) and **5** (right) against cancer cells from the wild type cell line, A2780.



$$\text{IC}_{50} = 10.66 \pm 0.63 \mu\text{M}$$



$$\text{IC}_{50} = 4.55 \pm 0.29 \mu\text{M}$$

Figure S20: Determination of the half maximal inhibitory concentration ( $\text{IC}_{50}$  in  $\mu\text{M}$ , logarithmic scale) for the conjugates **4** (left) and **5** (right) against cancer cells from the cisplatin-resistant cell line, 2780CP.

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