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Electronic Supplementary Information for

Non-aqueous bonding of leuprorelin to Ochratoxin A for peptide-based solid-phase extraction

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S1. Materials and Methods

S1.1 Samples

Solvents and chemicals were of HPLC-grade and reagent-grade quality, purchased commercially and used without further purification unless otherwise specified. The ochratoxin A standard sample was purchased from Fujifilm Wako Pure Chemical Corporation, while leuprorelin acetate was purchased from Tokyo Chemical Industry Co., Ltd. All the chemical reactions were performed under Ar atmosphere.

Preparation of Base Polymer. The base resin EG40 was obtained by the suspension copolymerization of glycidylmethacrylate (GMA) and ethylenedimethacrylate (EGDM), as previously reported:[S1] To a mixture of GMA (40 g), EGDM (60 g), and butyl acetate (80 g) was added 1.0 g of 2,2-azobis(isobutyronitrile) (AIBN) as the initiator for the polymerization reaction. The reaction mixture was then transferred to an aqueous solution (0.3 L) of 1% methylcellulose, and vigorously stirred to form an emulsion. The reaction temperature was increased to 80 °C (353 K), and the emulsion was stirred at 230 rpm for 7 h. Subsequently, the obtained base resins were vigorously washed with water, followed by methanol, and then dried at 60 ºC. The dried resin was sieved to achieve particle sizes of 45−90 μm using standard wire sieves.

The functionalization of leuprorelin. To a flask containing 5 mL of *N*,*N*-dimethylformamide (DMF) were added triphenyl phosphine (PPh_3, 1.60 mg, 6.1 μmol), leuprorelin acetate (7.73 mg, 6.1 μmol), and the base resin (EG40), and the reaction mixture was stirred at reflux for 4 h under a steady flow of Ar in the dark. The end of the reaction was monitored using thin-layer chromatography (TLC) with methanol as the eluent. The obtained resin was extensively washed with methanol using a Soxhlet extractor, and immersed in toluene for removing PPh_3 within the pore, followed by a 0.1 M Tris-HCl buffer solution (pH 7.0) at room temperature. It was dried under reduced pressure in a desiccator, and stored under Ar.

S1.2 Analysis of Prepared Samples

Nitrogen physisorption measurements were carried out at −196 °C (77 K) using a volumetric sorption analyzer (Microtrac BEL Corp., BELSOPR mini II), taking the molecular diameter of N_2 to be 0.354 nm. The specific surface area (S_{BET} in $m^2\ g^{-1}$) was calculated using the BET method in the pressure range of P/P_0 = 0.05–0.35 for the mesoporous materials.[S2] The mesopore size distribution was calculated by applying the Barrett–Joyner–Halenda (BJH) method to the N_2 adsorption isotherm.

Elemental Analysis. Elemental analysis of the obtained polymers for N atoms was performed *via* combustion ion chromatography using a LECO 928 series macro determinator. EDTA (N: 9.56%) was used as a standard material, and the samples were combusted at 1100 ºC with He as the carrier gas and O_2 for combustion. The quantitative analysis showed that the nitrogen content incorporated into the base gel (EG40) and *poly***1** was 0.04wt% and 0.48wt%, respectively. The presence of nitrogen in EG40 was due to the covalently-linked fraction of the polymerization initiator, azobis(isobutyronitrile) (AIBN). Thus, the net value of nitrogen incorporated into *poly***1** was 0.44wt%. This corresponds to 20 μmol g^{-1} of leuprorelin (**1**).

Functionalization of **1** with the polymer through the tyrosyl unit was corroborated using amino acid analysis. Hydrolysis was performed using an aqueous solution of 4 M methanesulfonic acid containing 0.2% 3-(2-aminoethyl)indole,[S3] resulting in the subsequent derivatization with *ortho*-phthalaldehyde and *N*-acetyl- *L*-cysteine (Table S1).[S4]

S1.3 Analysis of Homogeneous and Heterogeneous Association

Emission Spectroscopy. Steady-state emission spectra were recorded using a Shimadzu RF-5300 PC spectrofluorophotometer. A quartz cell with a path length of 1 cm was used for emission spectroscopy. The shape of the emission spectra for the OTA+**1** mixture was sensitive to the composition of solvents and choice of vessel in the system. In addition, we noticed that OTA was prone to attach to a quartz-cuvette during the storage, so a vessel made of polypropylene (PP) was finally chosen for preparation of diluted solution of OTA+**1** mixture. The followings are details:

Procedure A for Figure S1a: Approximately 100 µg of **1** weighed on a precision balance (XP2UV, Mettler-Toledo International Inc.) was added to a glass vial containing a magnetic stirring bar which was carefully washed with 1 M HCl and dried prior to use. To the vial was added 10 mL of dehydrated acetonitrile (Kanto Chemical Co. Inc.), and the solution was stirred for >3 h to prepare acetonitrile solution of **1** (8 µM). 1.00 mg of OTA weighted on a balance (AB265-S, Mettler-Toledo International Inc.) was added to a glass vial, and it was dissolved in 10 mL of dehydrated acetonitrile. The solution was then 20-times diluted (250 µL of the solution and 4.75 mL of dehydrated acetonitrile) to prepare acetonitrile solution of OTA (12.4 µM). Preparation of OTA+**1** mixed solution: To a vessel made of PP, 3.0 mL of dehydrated acetonitrile was added, and the weight was measured on a balance (XS104, Mettler-Toledo International Inc.). Then, 25 µL of 10 mM triethylamine solution (in dehydrated acetonitrile) and 6 µL of the 12.4 µM OTA solution (in dehydrated acetonitrile) were added to the vessel, and stood for overnight. This process was essential for achieving well-reliable emission spectra. Next morning, a specified amount of **1** solution was added to the mixture, and shaken for 3 h using a constant temperature shaker (Personal-11, Taitec Co.). The volume changes were analyzed by the weight changes. A few minutes of Ar bubbling was followed by its emission spectroscopic analysis with an excitation wavelength of 330 nm. Emission spectra were measured every 3 h with sequential **1** solution additions.

Procedure B for Figure S1b: Fundamentally the same protocol as that of Procedure A for Figure S1a, but the followings are the differences. For Figure S1b, no triethylamine (TEA) was used. In addition, the excitation wavelength was 280 nm. Emission spectra measurements were performed with bulk addition of **1** to OTA solution in acetonitrile instead of sequential addition. Equilibration was completed in about 30 min.

Procedure C for Figure 2: Fundamentally the same protocol as that of Procedure A for Figure S1a, but the following is different. For Figure 2, acetonitrile containing 10vol% of water was used for the preparation of the mixture of **1**+OTA: 2.7 mL of dehydrated acetonitrile, 0.3 mL of pure water and 6 µL of the 12.4 µM OTA solution (in dehydrated acetonitrile) were added to the PP vessel. After the emission spectroscopic analysis, a specified amount of **1** solution was added to the mixture, and shaken for 3 h using a constant temperature shaker (Personal-11, Taitec Co.). Emission spectrum at each concentration was obtained every 3 h by sequential addition of **1**.

Adsorption isotherms. Prior to determining the adsorption isotherm, we investigated the time required to achieve an adsorption equilibrium between the polymers and adsorbents. The Langmuir adsorption isotherms were obtained by fitting the experimental results: To acetonitrile or methanol solutions of OTA ($5 \times 10^{-3} - 2 \times 10^{-2}$ M), varied amounts (10 − 20 mg) of *poly***1** were added. The solutions were left in a bath at the specified temperature for the specified time required for equilibrium, and then the concentrations of OTA in the resulting solution were determined using high performance liquid chromatography (HPLC)−emission (Shimadzu Prominence 20 series) spectroscopy. Chromatographic separation for quantification was carried out on a GL Sciences InertSustain C18 column (25 cm × 4.6 mm i.d., 5 μm) at 313 K. 1:1 (v/v) mixture of acetonitrile and 4% acetic acid aqueous solution was used as the eluent at a flow rate of 1.0 mL min^{-1}. Detection of OTA was performed using an excitation wavelength of 330 nm and an emission wavelength of 470 nm.

The temperature-dependence of the equilibrium constants was investigated at temperatures ranging from 253 to 313 K using the relationship between the logarithm of the equilibrium constant (K) and the reciprocal of the temperature ($1/T$) based on the following equations under constant pressure:

$$\ln K = -\,\Delta H/(RT) + \Delta S/R \qquad (1)$$

where ΔH is the enthalpy change in J mol^{-1}, ΔS is the entropy change of a reaction (herein, the adsorption and desorption events, J K^{-1} mol^{-1}), T is the temperature for equilibrium in K, and R is the gas constant (8.314 J K^{-1} mol^{-1}). The association of the OTA/*poly***1** pair was regarded as the bi-Langmuir mode with two different binding constants (K_1 and K_2), and the total fitting of the K_1 and K_2 values at each temperature was achieved with the other variants of the saturated value for adsorption (θ_{sat}). A linear relationship between ln K and $1/T$ validated the model where the thermodynamic parameters (ΔH and ΔS) remained almost the same in the investigated temperature region. Again, all the data in acetonitrile were treated as a bi-Langmuir model: *poly***1** possesses two distinct types of adsorption sites, one stronger than the other. As OTA was hardly adsorbed onto the surface of the base resin in acetonitrile, these adsorption sites were closely related to the immobilized functional groups.

Modified Benesi–Hildebrand Method. Benesi & Hildebrand reported a thermodynamic analysis of the acid-base interaction of iodine with aromatic hydrocarbons[S5] based on steady-state absorption in the visible and ultraviolet regions. We instead used the visible emission of OTA, which showed a marked bathochromic shift upon association with leuprorelin, along with enhanced intensity of the emission. The equilibrium constant for the homogeneous events was derived as follows: Provided that there is an association reaction for **1** + OTA ⇄ **1**-OTA in a 1:1 manner as shown in Figure 2b, the equilibrium constant (K) is defined as

$$K = [\mathbf{1}\text{-OTA}] \,/\, (([\mathbf{1}]_{\mathrm{i}} - [\mathbf{1}\text{-OTA}])\,([\mathrm{OTA}]_{\mathrm{i}} - [\mathbf{1}\text{-OTA}])) \qquad (2)$$

where [**1**-OTA] is the concentration of the 1:1 associate form between **1** and OTA at equilibrium and the subscript i represents the initial concentration. Under the condition [**1**] >> [OTA],

$$K = [\mathbf{1}\text{-OTA}] \,/\, ([\mathbf{1}]_{\mathrm{i}}\,([\mathrm{OTA}]_{\mathrm{i}} - [\mathbf{1}\text{-OTA}])) \qquad (3)$$

Regarding the change in the emission intensity upon association, the relationship is expressed as

$$\mathrm{FL} = \mathrm{FL}_0 + \mathrm{FL}_{\mathrm{eq}} = c_0\,([\mathrm{OTA}]_{\mathrm{i}} - [\mathbf{1}\text{-OTA}]) + c_{\mathrm{eq}}\,[\mathbf{1}\text{-OTA}] \qquad (4)$$

where FL is the experimentally determined fluorescence intensity at a wavelength, FL_0 and $\mathrm{FL}_{\mathrm{eq}}$ are the fluorescence intensities without the association and at equilibrium with the association, respectively. c_0 and c_{eq} are the coefficients for the emission from the pristine OTA and the associated form **1**-OTA, respectively. Rearranging eq. 4 yields:

$$[\mathbf{1}\text{-OTA}] = (\mathrm{FL} - c_0\,[\mathrm{OTA}]_{\mathrm{i}}) \,/\, (c_{\mathrm{eq}} - c_0) \qquad (5)$$

Integration of eqs. 5 into eq. 3 gives eq. 6:

$$K = (\mathrm{FL} - c_0\,[\mathrm{OTA}]_i) / ([\mathbf{1}]_i\,(c_{eq}\,[\mathrm{OTA}]_i - \mathrm{FL})) \quad (6)$$

We can regard the term "$\mathrm{FL} - c_0\,[\mathrm{OTA}]_i$" as the difference caused by the newly formed CT emission, and therefore, the term is expressed as ΔFL.

$$K \bullet [\mathbf{1}]_i = \Delta\mathrm{FL} / (c_{eq}\,[\mathrm{OTA}]_i - \Delta\mathrm{FL} - c_0\,[\mathrm{OTA}]_i) \quad (7)$$

Rearranging eq. 7 yields the final form eq. 8:

$$\frac{[\mathrm{OTA}]_i}{\Delta\mathrm{FL}} = \frac{1}{\mathrm{K}[1]_i} \cdot \frac{1}{\mathrm{c}_{eq} - \mathrm{c}_0} + \frac{1}{\mathrm{c}_{eq} - \mathrm{c}_0} \quad (8)$$

Thus, the plot of $[\mathrm{OTA}]_i/\Delta\mathrm{FL}$ versus $1/[\mathbf{1}]_i$ shows a linear relationship with a slope of $1/K(c_{eq} - c_0)$ and an intercept of $1/(c_{eq} - c_0)$.

Hill plot.[S6] Intercept of eq. 8 is the reciprocal of the difference in the coefficients of emission between OTA and **1**-OTA. Dividing the initial concentration of OTA by the intercept gives the maximum value of ΔFL, because $c_{eq}[\mathrm{OTA}]_i - c_0[\mathrm{OTA}]_i = c_{eq}[\mathbf{1}\text{-OTA}]_\infty - c_0[\mathrm{OTA}]_i$; where the subscript ∞ represents limiting concentration. Using this maximum value, [Leu-OTA] can be calculated from the ΔFL value for any [Leu]. The Hill plot parameter, θ, is the ratio of the associated form to the free form of OTA, [Leu-OTA] / [OTA]. The plot of $\log(\theta/(1-\theta))$ against log [Leu] is called the Hill plot.

For both Benesi-Hildebrand and Hill plots, the concentration of additives (herein leuprorelin, **1**) should be at least an order of magnitude higher than that of OTA. As such, the emission spectra of OTA+**1** with a lower concentration of **1** were not considered in these analyses. For example, in Figure 2, 25 nM of OTA was used, so the corresponding spectra with concentrations of **1** lower than 200 nM were not considered for the plot.

S1.4 Quantum Chemical Calculations

Density functional theory (DFT) calculations were performed using the Gaussian 16 package.[S7] The total number of the atoms (N) in the associated form of **1**+OTA is 217. The computational cost of standard DFT methods in general increases with N^3,[S8] and the computational investigation including the geometry optimization and frequency analysis for the associated pair with $N = 217$ was prohibitively costly even with a supercomputer. As such, the functional used in this study was a balance between computational cost and accuracy. Based on previous studies,[S9] we selected the local functional of M06-2X[S10] together with Grimme's-D3 dispersion correction[S11] to perform geometry optimization of the local minima (EQs). The 3-21G basis set was employed for the initial geometry optimization, while the refinement of structures was achieved using the 6-31G(d,p) basis set. Solvent effects were considered in an implicit solvent model (polarizable continuum model, PCM) with acetonitrile as the solvent for all calculations. Harmonic frequency analyses were also conducted using the 6-31G(d,p) basis set. The configuration is crucial for the energy and enthalpy of optimized geometries, and therefore, as may initial configurations as possible were investigated, and the most stable geometry for each molecule was reported. The Cartesian coordinates of each molecule are presented in section S3.

S1.5 Temperature-Dependent Solvent Exchanges using Acetonitrile

The permeability of the solvents into the pores of the polymers was measured by NMR. ^{1}H nuclear magnetic resonance (NMR) spectra were recorded using a JEOL ECS400 spectrometer (400 MHz) in CD_3CN. Chemical shifts were reported in δ ppm units with reference to the internal standard tetramethylsilane ($Si(CH_3)_4$, 0.00 ppm). 10 mg of dried EG40 was placed in a 1 mL barrel-type cartridge sandwiched between two frits. The unnecessary parts of the cartridge were removed. The slimmed-down cartridge was placed into a 2 mL micro-tube, followed by the addition of 1 mL of acetonitrile, and was incubated in a stirred water bath at 0 °C or 40 °C for 50 min. After permeation of the solvents, the cartridge was dried by Ar flow for 1 min. The dried cartridge was transferred to another microtube, followed by the addition of 0.6 mL of deuterated acetonitrile and 50 μL of an internal standard prepared by diluting 50 μL chloroform with 0.3 mL deuterated acetonitrile). The cartridge containing the deuterated solvent was incubated in a stirred water bath at the same temperature for 30 min. After incubation, the supernatant solution was placed in an NMR tube, and the ^{1}H NMR spectra were measured.

S2. Supplementary Figures, Tables, and Discussions

S2.1 Homogeneous Physisorption Analysis using OTA

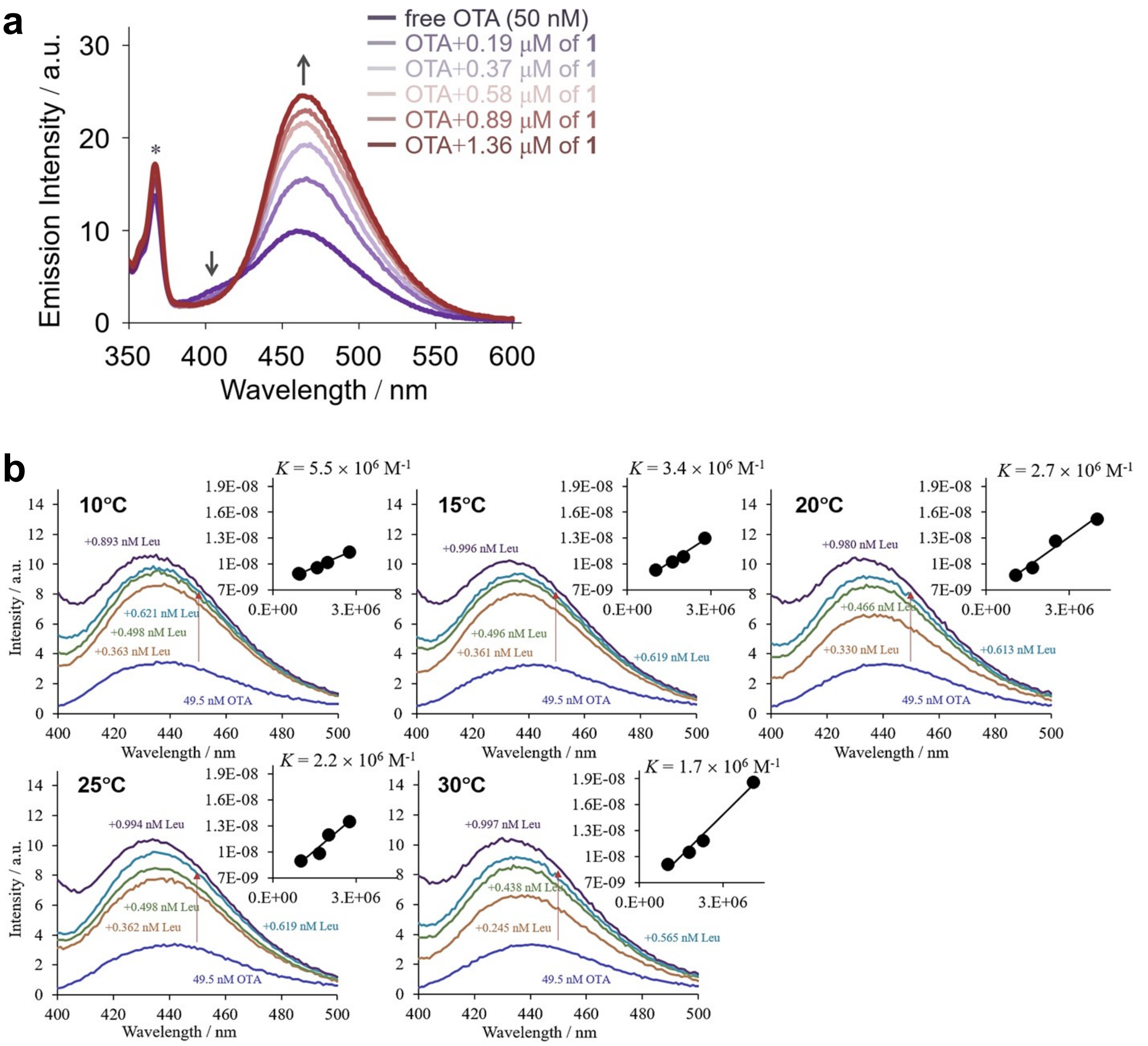


Figure S1. Steady-state emission spectra of OTA with varying concentrations of **1** in anhydrous acetonitrile (a) with 0.1 mM of triethylamine (TEA) at 298 K and (b) without TEA at the specified temperature. Excitation wavelength was 330 nm for Figure S1a and 280 nm for Figure S1b. The inset shows the Benesi–Hildebrand plot.

S2.2 Analysis of Functionalized Polymer

Table S1. Amino acids obtained upon the hydrolysis of 0.2 g *poly***1** in 4 M methane sulfonic acid containing 0.2% 3-(2-aminoethylindole).

	M_w	mg / 0.2 g *poly***1**	amount in µmol/g	
			hydrolysis	Elemental analysis
L-Tryptophan	204.23	0.21	0.52	21
D-Leucine	131.17	0.31	1.2	
L-Leucine	131.17	1.13	4.3	
L-Tyrosine	181.19	n.d.[a]	n.d.[a]	
L-Serine	105.09	2.94	14	
L-Histidine	155.15	0.37	1.2	
L-Arginine	174.20	0.35	1.0	
L-Proline	115.13	n.d.[b]	n.d.[b]	

[a] not detected. [b] Proline was not detected in this method because it is a secondary amine

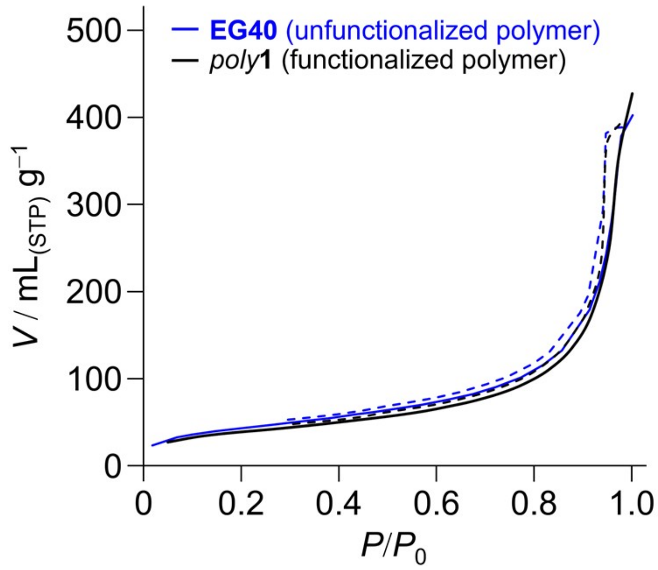


Figure S2. Adsorption isotherm for nitrogen adsorption/desorption of *poly***1** (black) and base polymer (EG40, blue). Solid lines: adsorption isotherms; dashed lines: desorption isotherms.

Table S2. Summary of the gravimetric surface area and functionalized leuprorelin

	S_{BET} / m^2 g^{-1}	immobilized **1** / mol g^{-1}	surface density of **1**	
			in mol m^{-2}	counts per nm^2
EG40	157	-	-	-
*poly***1**	139	2.1×10^{-5}	1.5×10^{-7}	0.09

S2.3 Heterogeneous Physisorption Analysis using OTA

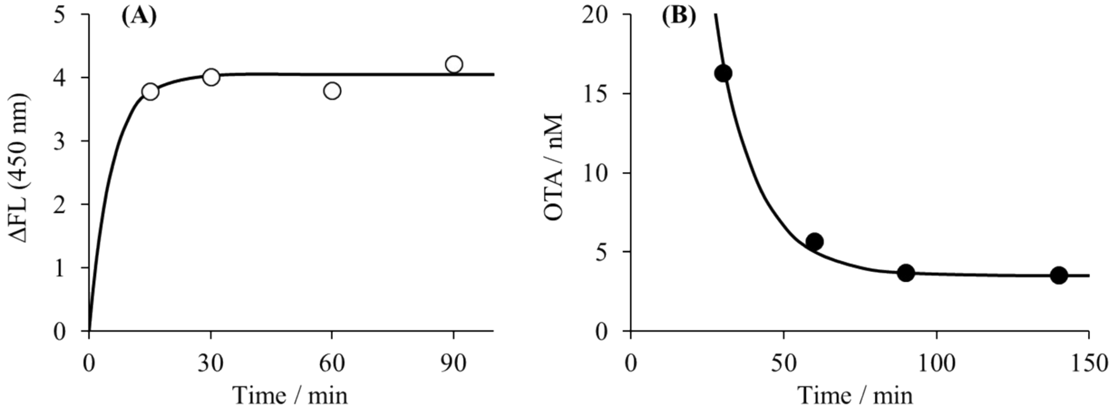


Figure S3. Time-course of the concentration of OTA in acetonitrile in the presence of (**A**) **1** (0.294 μM) and OTA (initial concentration: 42.9 nM) or (**B**) *poly***1** (10.2 mg) and OTA (initial concentration: 124 nM) at 293 K.

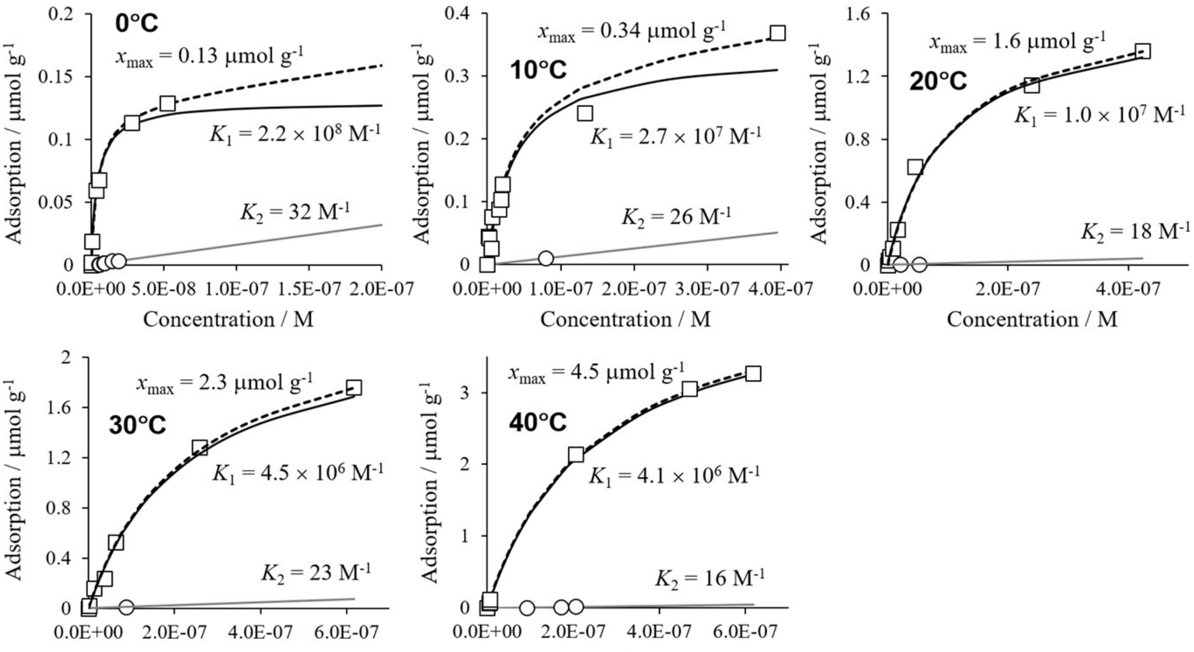


Figure S4. Adsorption isotherms using OTA as a substrate and *poly***1** as a stationary phase in acetonitrile at the specified temperature. The vertical axis shows the amount of the adsorbed substrate per gram of *poly***1**, while the horizontal axis shows the equilibrium concentration of the substrate in the solution. Bi-Langmuir behavior was observed at each temperature (K_1 and K_2 with solid plots). The squares represent the experimental values, and the dashed line indicates the sum of K_1 and K_2 plots.

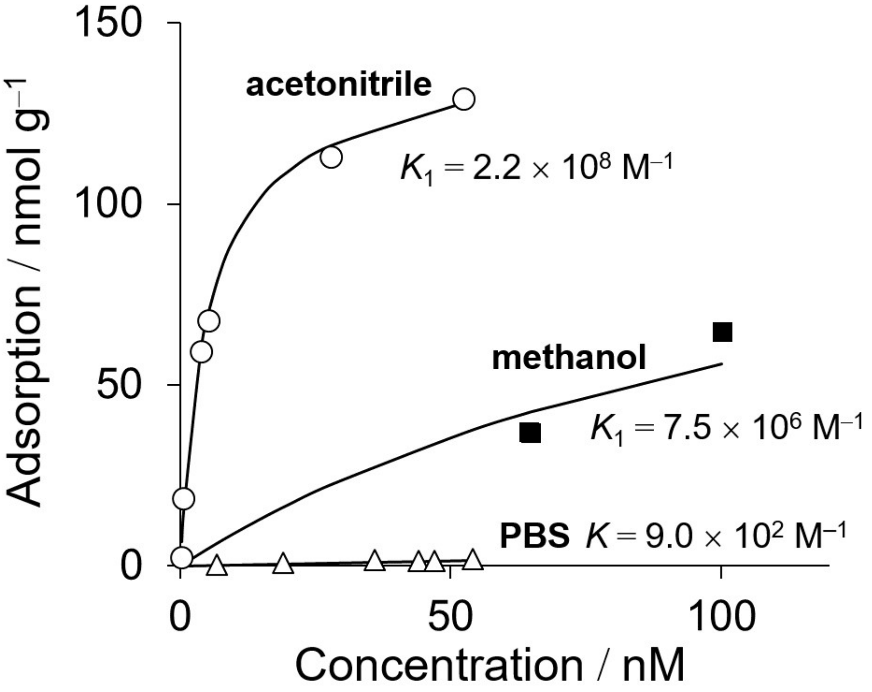
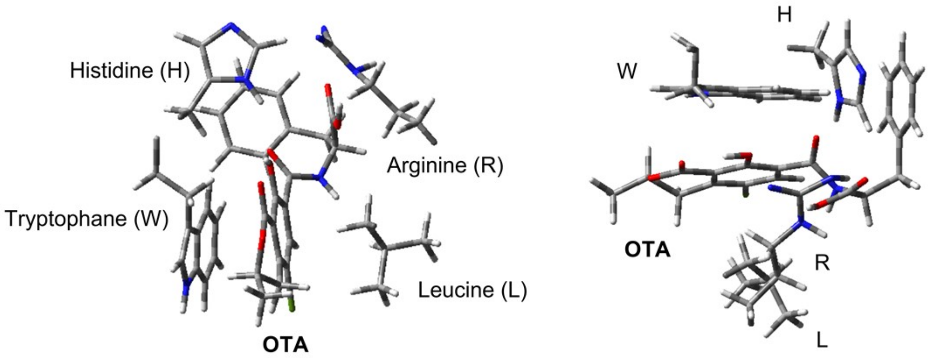


Figure S5. Adsorption isotherms using OTA as a substrate and *poly***1** as a stationary phase in acetonitrile (white circle), methanol (black square), and PBS (white triangle) at 0ºC. The vertical axis shows the amount of the adsorbed substrate per gram of *poly***1**, while the horizontal axis shows the equilibrium concentration of the substrate in the solution.

S2.3 DFT Calculations

The association energy for intermolecular interactions was sensitive to the rotational configuration of each peptide residue. The most stable geometry was obtained for the **1**+OTA pair among the 32 structures optimized with different initial configurations. Although the incorporation of the solvent effect was inadequate, the calculations for evaluating the association enthalpy for **1**+OTA ($\Delta H = -27$ kJ mol^{-1}, Figure 4c) are in good agreement with the experimentally determined enthalpy changes in acetonitrile ($\Delta H = -34$ kJ mol^{-1}, Figure 4a). In the optimized geometry for the **1**+OTA pair, the carboxylic acid of OTA and basic residues (arginine and histidine) of **1** are in close proximity, while tryptophan and leucine units of leuprorelin would provide substantial π–π stacking and hydrophobic interactions with the isocoumarin backbone of OTA, resulting in a large association energy. The computationally obtained structures for OTA and the selected residues in the associated pair are shown below:

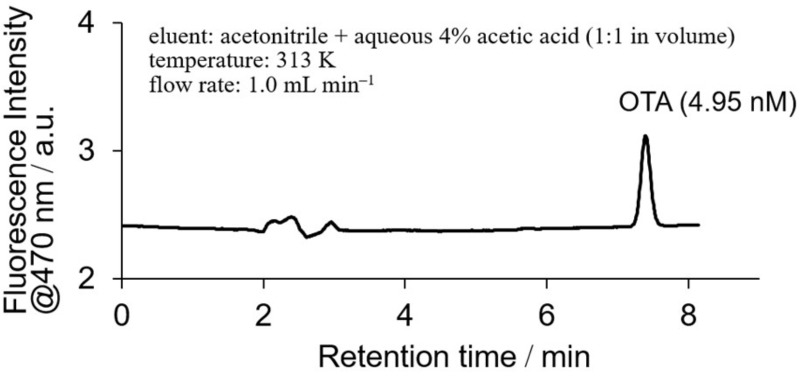


S2.4 Chromatograms obtained with the Newly Prepared Polymer having **1**

A 1-g sample of coffee beans that had been ground through a 425-µm mesh screen was placed in a 50 mL screw-capped PP tube. Citrate buffer solution (7 mL of 0.1 M, pH 3.0) was added, and autoclaved at 121°C for 10 min. After cooling, the solution pH was adjusted to 6. To the solution, 100 µL of cellulase solution and 1 mL of 1% hemicellulase aqueous solution were added to hydrolyze cellulose,[S12,S13] and the volume was fixed at 10 mL. The cell wall was digested by placing the PP tubes in an incubator at 60°C for 3 h. The PP tubes were centrifuged at 10,000 rpm for 5 min.

A commercially available immunoaffinity column was conditioned by passing 2-3 mL of acetonitrile. A 1 mL aliquot of 3 ng OTA mL^{-1} acetonitrile solution was applied to the cartridge and left for 5 min for equilibration. A flow rate was set to 1 drop sec^{-1}. After all of the solution had flowed through, the column was washed with 0.25 mL of acetonitrile. The adsorbed OTA was eluted using 1 mL of methanol containing 2% of acetic acid at a flow rate of 1 drop sec^{-1}. Similarly, ten mg dry weight of *poly***1** was packed in 1 mL of solid-phase extraction (SPE) cartridge. The cartridge was conditioned by passing 2-3 mL of acetonitrile. A 0.6 mL aliquot of 5 ng OTA mL^{-1} acetonitrile solution was applied to the cartridge and left for 5 min for equilibration. A flow rate was set to 1 drop sec^{-1}. After all of the solution had flowed through, the column was washed with 0.15 mL of acetonitrile. The adsorbed OTA was eluted using 1 mL of methanol containing 2% of acetic acid at a flow rate of 1 drop sec^{-1}.

Limit of detection (LOD) and limit of quantification (LOQ), based on the signal-to-noise ratio criterion[S14] using the chromatogram shown below, were 0.03 nM and 0.1 nM, respectively, for OTA in this work.



The accuracy of the measurements using *poly***1** was evaluated by three times of investigation performed with a raw coffee bean spiked with 2.48 pmol of OTA. The experimental recovery was 96.0 ± 3.1%, which was considered satisfactory.

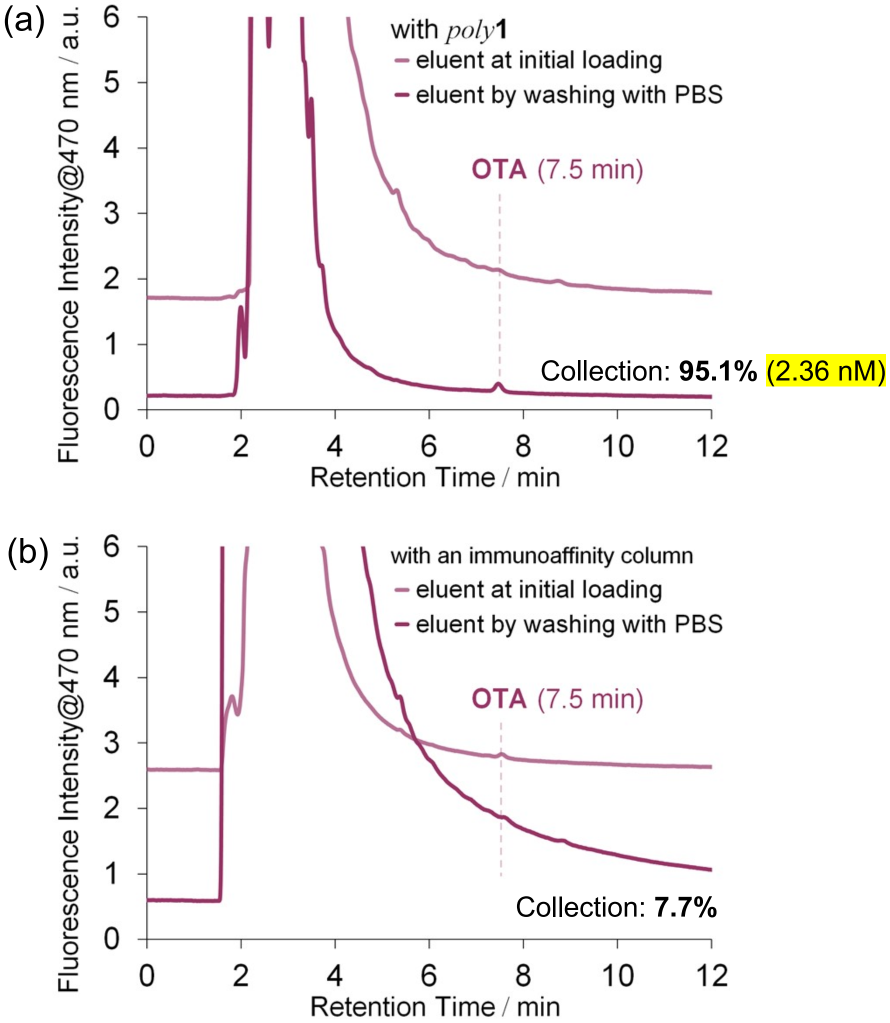


Figure S6. Chromatograms showing (i) eluents at initial loading of a matrix solution extracted from green coffee beans with added OTA and (ii) eluents by washing with PBS on (a) *poly***1** and (b) a commercially available immunoaffinity column. The detected value of 2.36 nM (95.1%) was much larger than the LOQ (0.1 nM) as previously described, validating the quantification.

As shown in Figure S6a, good collection efficiency of 95% was achieved using *poly***1** a matrix solution extracted from green coffee beans with added OTA. We also conducted the similar experiment using a matrix derived from wheat (Figure S7). We used a certified wheat sample, which was naturally contaminated with OTA (Trilogy Anal. Lab., Washington, MO, USA). 5.11 nM OTA was recovered after extraction following the loading, and this value was in a good agreement with a certified value of 4.80 ± 0.68 nM. Because coffee extract has been regarded as the most tedious and challenging matrix in the field of food chemistry,[S15,S16] these results clearly demonstrate the potential of the current system for efficient extraction of OTA from heavily contaminated food matrices. In fact, we can easily recognize the marked difference in the amount of contaminations (appeared at retention time of 2~6 min) when comparing Figure S6a and Figure S7. To the best of our knowledge, this is the first example for non-aqueous system to efficiently and repeatedly capture/release OTA from heavily contaminated food matrices.

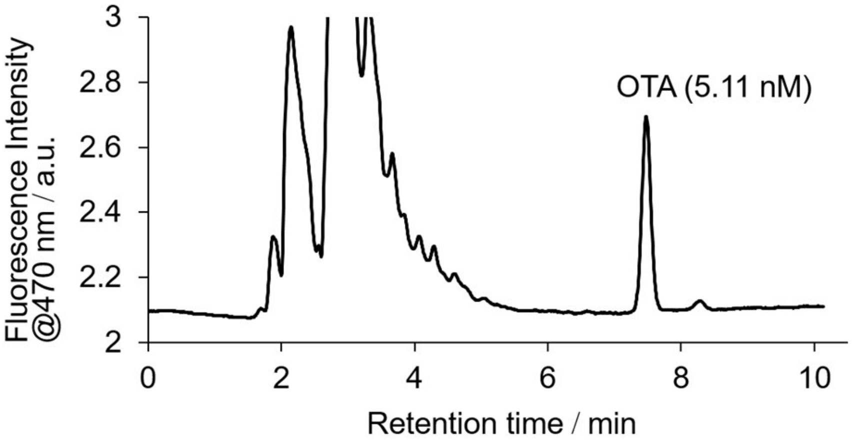


Figure S7. Chromatograms showing eluents by eluting with 2% AcOH/MeOH 1 mL on *poly***1** following an initial loading of a matrix solution extracted from a wheat reference material naturally contaminated with OTA using acetonitrile.

S2.5 Temperature-Dependent Solvent Exchanges using Acetonitrile

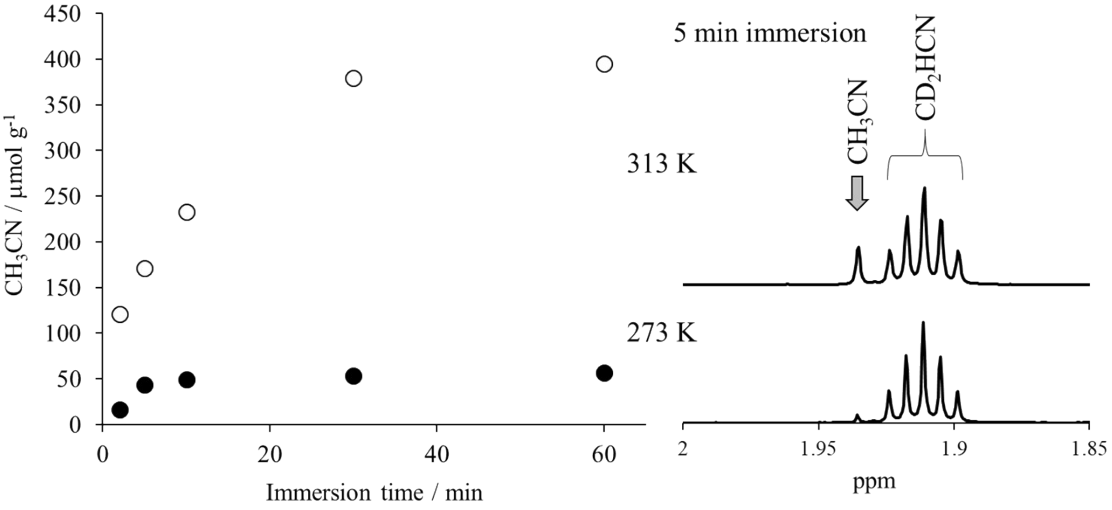


Figure S8. (left) Time-course of the amount of exchanged acetonitrile. (right) Representative ^{1}H NMR spectra of the obtained solution showing partly deuterated CD_2HCN as a quintet and the exchanged CH_3CN.

Acetonitrile that permeated into EG40 exuded into deuterated acetonitrile during the solvent-exchange experiment. Temperature-dependence showed that 8-times larger exchange was observed at 313 K as compared with that at 273 K within 60 min (Figure S8). This rationalizes the larger number of maximum sites for binding at higher temperatures as shown in Figure S3. The time-course profile of solvent exchange follows the Weber-Morris model (Figure S8),[S17] which is typically used as an intra-particle diffusion equation for a series of resins,[S18] represented by the following equation,

$$Q_t = k_d d_t^{1/2} + I$$

where Q_t (µmol g^{-1}) is the amount of exchange at time t (min), k_d (µmol min g^{-1}) is the diffusion constant, and I (µmol/g) is the intercept, which is related to the boundary layer thickness. The diffusion constant of 63.7 µmol min g^{-1} at 313 K was ca. 8 times larger than that of 7.53 µmol min g^{-1} at 273 K, and the good correlation indicates intra-particle diffusion to be the rate-limiting step.

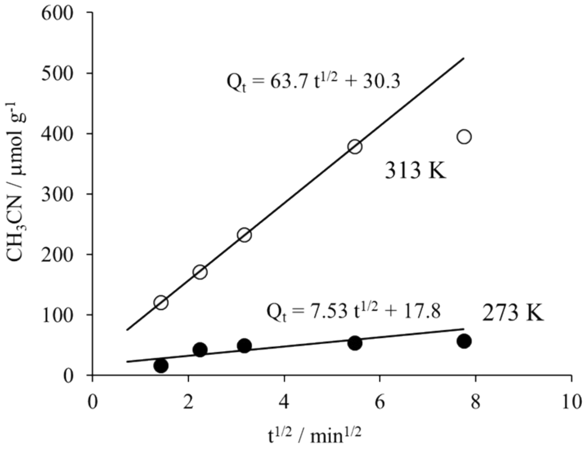


Figure S9. Relationship between time and the exchanged acetonitrile that follows the Weber-Morris model.

Table S3. Summary of the pore volumes of EG40 determined by N_2 physisorption at 77 K and the amounts of exchanged acetonitrile

N_2 physisorption	microporosity V_{micro} / mL g^{-1}	0.22[a]
	mesoporosity V_{meso} / mL g^{-1}	0.42[a]
Solvent exchange	at 0 °C / mL g^{-1}	0.003
	at 40 °C / mL g^{-1}	0.023

[a] The pore volume for the mesoporosity (V_{meso}) was calculated with the following relationship using a total pore volume (V_{total}) determined by nitrogen physisorption at $P/P_0 = 0.98$: $V_{meso} = V_{total} - V_{micro}$.[S2]

References

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S3. Appendix: Optimized Structures and Energies in Quantum Chemistry Calculations

Cartesian coordination of **1**+OTA optimized using a M06-2X functional together with the 6−31G(d,p) basis set in Ångström. The geometry shown below was the most stable among 32 structures optimized from different initial configurations. $E_{(\mathrm{RM062X})}$ = –5815.12686238; Sum of electronic and thermal Enthalpies = –5813.186557.

O	-1.93049839	4.46430452	3.30073109
C	-2.85950122	5.33368698	2.67976163
C	-3.06054762	4.89934147	1.21545277
C	-1.71191757	5.18275988	0.52592178
N	-1.16880522	4.13822123	-0.12443284
C	0.24156518	3.94482850	-0.36987138
C	0.91519916	3.57478234	0.97124703
N	1.84782105	2.61723035	0.86618962
C	2.33979133	1.83210492	1.97189325
C	2.28474322	0.37437494	1.50930827
N	2.52871440	-0.58028601	2.44661362
C	3.05833432	-1.86180352	1.96237781
C	4.21664560	-1.49459164	1.00205939
N	4.36021122	-2.18470022	-0.15192495
C	5.11898834	-1.60887844	-1.25883362
C	6.48169204	-1.04476014	-0.82544016
N	7.35165806	-1.87635259	-0.23191110
O	-1.19080173	6.28171284	0.67073441
N	-3.41498867	3.48274693	1.24955546
C	-4.67431904	3.00440809	1.06863581
C	-5.03775310	1.78386195	1.92733452
O	-5.50981691	3.54318985	0.34927210
N	-6.10270673	0.97146668	1.36554612
C	-6.35430071	0.36229527	0.17561350
C	-3.84354019	0.96389652	2.45630917
C	-4.21563014	-0.25555912	3.24414487
C	-4.19837017	-0.38033817	4.60982565
N	-4.46658717	-1.67853962	4.96976859
C	-4.67713288	-2.42824367	3.83791277
C	-4.53956263	-1.55968792	2.72731694
C	-4.95802480	-3.79220841	3.69108077
C	-5.11644862	-4.27510250	2.40167917
C	-4.99397945	-3.42790757	1.28109461
C	-4.70572215	-2.08517688	1.43759161
C	-5.50796325	0.62244148	-1.08065442
O	-7.33943190	-0.35851473	0.07103625
N	-4.10543664	0.88371561	-0.81944507
C	-3.30099035	1.73475015	-1.51252635
C	-3.89505015	2.71437054	-2.53436730
O	-2.08883394	1.76075424	-1.29095920
C	-2.93511999	2.88144513	-3.73730538
C	-2.10854986	4.12460923	-3.40247390
C	-2.97417103	4.89819153	-2.41845395

N	-3.94427105	4.05339528	-1.97891134
C	-5.66884192	-0.55558132	-2.06641317
C	-5.06104195	-0.25552863	-3.39312740
N	-5.74846912	0.37260159	-4.40879064
C	-4.89946814	0.52548313	-5.45594338
N	-3.70803852	0.04088077	-5.18167670
C	-3.79763573	-0.44479385	-3.89500484
O	-2.83589862	6.05869923	-2.06316532
O	0.60063459	4.10547647	2.03698926
C	0.97688682	5.09221595	-1.09634082
C	2.41054565	4.65907964	-1.29868970
C	3.42021327	5.16116350	-0.47505556
C	4.67414349	4.56311908	-0.41643558
C	4.93926399	3.42538014	-1.18135518
C	3.97466426	2.97699480	-2.09020778
C	2.72183951	3.58511928	-2.14118506
O	6.14138037	2.81490423	-1.01457489
C	3.78312417	2.20582035	2.34938334
C	3.91743670	3.61380560	2.93331844
O	2.09252728	0.07840256	0.33332728
C	3.14672489	3.76392394	4.24625900
C	5.39955108	3.92884281	3.13986575
C	1.93918397	-2.77757351	1.43303936
C	2.07750277	-4.27422011	1.76317147
C	3.21928135	-4.97347591	1.02453236
C	2.18721391	-4.51408448	3.27146242
O	4.98507545	-0.58962222	1.30579596
C	4.30851393	-0.52206374	-1.96454759
C	2.99690888	-1.03958619	-2.54161658
C	2.20149925	0.09536985	-3.17135172
N	1.01616235	-0.43642760	-3.84884072
C	0.16189322	0.50136415	-4.47797562
N	-0.74845604	-0.11584069	-5.30121105
N	0.32762206	1.75395122	-4.25812030
O	6.79411903	0.11921244	-1.11825726
C	7.07337094	-3.23944773	0.25600307
C	8.43385919	-3.70562754	0.76920522
C	9.04409206	-2.41023357	1.31278360
C	8.65926182	-1.38408600	0.24938779
C	9.68381269	-1.36506975	-0.90643225
O	10.58794620	-2.19271421	-0.98539107
N	9.50702520	-0.37277221	-1.80000695
C	10.28863286	-0.31341904	-3.02574319
C	9.77933992	-1.28955654	-4.08243734
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H	-3.80167934	5.23188599	3.22458948
H	-2.53264747	6.37698189	2.70693662
H	-3.85351437	5.47054920	0.72579403
H	-1.70950889	3.27947260	-0.16476242
H	0.29375009	3.06328059	-1.02032401
H	2.00484874	2.19587866	-0.04371579

H	1.66812030	1.97714287	2.82400792
H	2.87382168	-0.26017956	3.34336892
H	3.52943046	-2.33115519	2.83160093
H	3.65425716	-2.86290599	-0.40215351
H	5.32721260	-2.43003409	-1.95668498
H	-2.81822195	2.98268722	1.90237422
H	-5.49898258	2.25104323	2.80807201
H	-6.78620053	0.66865803	2.05054977
H	-3.24664793	1.61297548	3.11030317
H	-3.20607042	0.68406730	1.61104107
H	-4.01291089	0.36963346	5.36722010
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H	-5.04608210	-4.44222316	4.55593166
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H	-5.09511036	-3.83468922	0.27980482
H	-4.56132775	-1.46453800	0.55830880
H	-5.94908588	1.53220236	-1.49959923
H	-3.56288739	0.12114658	-0.40590763
H	-4.88245570	2.40218140	-2.87378422
H	-3.53196059	3.04130086	-4.63828229
H	-2.33177974	1.98548212	-3.87823245
H	-1.17947550	3.85613692	-2.88714845
H	-1.86024008	4.74523537	-4.26557599
H	-4.59329571	4.29149408	-1.23182647
H	-5.17289823	-1.43696304	-1.64284334
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H	-6.72230169	0.64797186	-4.38909111
H	-5.20125181	0.99043004	-6.38364338
H	-2.96447513	-0.93060230	-3.39995373
H	0.45451257	5.27977312	-2.04167909
H	0.91933404	6.00045825	-0.49404018
H	3.20449661	6.00332978	0.17889023
H	5.44078610	4.93756477	0.25464968
H	4.20597525	2.14159918	-2.74418330
H	1.96767455	3.18093535	-2.81958470
H	6.11711760	1.87744426	-1.29593879
H	4.17816001	1.47950285	3.07175561
H	4.40086399	2.11133640	1.44613698
H	3.50376257	4.32156277	2.20264613
H	3.33866672	4.74520388	4.69313484
H	2.06769892	3.67545300	4.09119417
H	3.46379500	3.00006057	4.96795112
H	5.54237713	4.96305643	3.46929665
H	5.97054476	3.77860518	2.21725781
H	5.82565349	3.26999724	3.90655102
H	1.01987189	-2.42611368	1.90939129
H	1.78325650	-2.62429410	0.35717571
H	1.13659460	-4.73488085	1.42990629
H	3.25654163	-6.03320892	1.29499706
H	3.09386986	-4.91812067	-0.06334779
H	4.19052533	-4.53426353	1.28391999

H	2.01090975	-5.56844673	3.50483466
H	1.45295208	-3.91748216	3.82413108
H	3.18405639	-4.26176729	3.65006163
H	4.10628931	0.27431282	-1.23755082
H	4.92647546	-0.09744231	-2.76305318
H	3.20304572	-1.81629141	-3.29144759
H	2.38673449	-1.49078468	-1.75177736
H	1.86510170	0.78795435	-2.39480909
H	2.81725088	0.66833429	-3.87847628
H	1.27473078	-1.16355490	-4.51746209
H	-1.61076066	0.38488893	-5.50790382
H	-0.94333485	-1.08881544	-5.06547374
H	-0.38350299	2.28988693	-4.75667749
H	6.66158394	-3.86463733	-0.54058705
H	6.35085461	-3.19516151	1.07677044
H	8.33290202	-4.48816448	1.52331401
H	9.04684198	-4.08048974	-0.05454535
H	10.12485710	-2.46606133	1.44149411
H	8.57900468	-2.13907570	2.26546879
H	8.53110879	-0.36976120	0.63866285
H	8.65687279	0.17784145	-1.71693310
H	10.25017046	0.71462835	-3.39341499
H	11.32628319	-0.53981428	-2.76872668
H	10.38611361	-1.22801297	-4.99032383
H	9.82983438	-2.31232027	-3.69883680
H	8.74068733	-1.06674201	-4.34399507
C	-1.75812879	-2.66862263	0.93898120
C	-1.69374767	-3.53512552	2.01802848
C	-1.32245383	-3.06751948	3.28004755
C	-0.95980660	-1.74138562	3.47951336
C	-1.05298289	-0.85395721	2.39129715
C	-1.46264588	-1.30585803	1.12187538
C	-0.39391237	-1.22102700	4.77055283
C	-0.66035407	0.26249134	4.94795155
O	-0.32265933	1.01142451	3.75155042
C	-0.69493730	0.56817008	2.55450055
C	-2.11221231	-3.12093868	-0.44960543
N	-1.41150432	-4.21646558	-0.87330442
O	-2.90046222	-2.52175240	-1.16409062
O	-1.59426745	-0.50293133	0.06281041
O	-0.71303949	1.36626608	1.62369956
C	0.14755576	0.88547939	6.06462787
Cl	-1.31272303	-4.19945021	4.60892407
C	-1.17912260	-4.42980575	-2.29595229
C	-2.21723875	-5.29466894	-3.02444918
C	-0.86451438	-3.10743164	-3.00337731
O	-0.16175810	-2.28697219	-2.24460127
O	-1.14130777	-2.89376590	-4.16991485
C	-3.65712862	-4.84916349	-2.95535331
C	-4.50937814	-5.38744842	-1.98803706
C	-5.85072718	-5.01184579	-1.93012928

C	-6.35641388	-4.08728218	-2.84204258
C	-5.51366905	-3.54935332	-3.81418812
C	-4.17518515	-3.92875319	-3.87061408
H	-1.96052036	-4.58070982	1.89271550
H	-0.82004250	-1.75207635	5.62545378
H	0.68971420	-1.40868850	4.77579013
H	-1.73118884	0.41970482	5.10957260
H	-0.65592397	-4.50861739	-0.26717629
H	-1.27094945	0.40599657	0.26784393
H	1.21685957	0.76420639	5.86554075
H	-0.07913783	1.95073758	6.14803658
H	-0.09320685	0.39817815	7.01257398
H	-0.23171617	-4.97950395	-2.35302435
H	-1.89460104	-5.35332411	-4.06856585
H	-2.13380849	-6.30085492	-2.60200166
H	0.15859126	-1.50042479	-2.79484814
H	-4.11848642	-6.11070217	-1.27560788
H	-6.50030225	-5.44286720	-1.17323035
H	-7.40101712	-3.79332562	-2.80015872
H	-5.89842632	-2.82752756	-4.52966380
H	-3.51787925	-3.49962612	-4.62114207

Cartesian coordination of **1** optimized using a M06-2X functional together with the 6−31G(d,p) basis set in Ångström. The geometry shown below was the most stable among 12 structures optimized from different initial configurations. $E_{(\mathrm{RM062X})}$ = –4076.26645139; Sum of electronic and thermal Enthalpies = –4074.712690.

O	-6.58007879	4.11590328	-1.20135923
C	-5.78064263	3.03185149	-0.78752727
C	-4.51659517	2.91825786	-1.64486180
C	-3.63782702	4.17098068	-1.49625631
N	-2.40083321	4.05453076	-2.06616173
C	-1.21125214	4.60947778	-1.43955136
C	-1.00150039	3.91002006	-0.07668402
N	0.24155257	3.99096710	0.42495382
C	0.59057357	3.50938908	1.74333394
C	0.57122614	1.97149509	1.80553397
N	0.84385943	1.47803534	3.04050810
C	0.85712473	0.05258391	3.36294071
C	1.65438906	-0.70837642	2.28901528
N	2.81659721	-0.12451209	1.93554194
C	3.50076510	-0.39943300	0.67730145
C	4.82687506	-1.11429398	0.95875152
N	4.95631973	-2.40722389	0.58496576
O	-4.03053791	5.16265756	-0.89821222
N	-3.68767092	1.79199174	-1.25051237
C	-3.86900474	0.54339318	-1.70893374
C	-2.78105304	-0.44114582	-1.31244240
O	-4.81017595	0.20247135	-2.42661130
N	-3.39818561	-1.68982157	-0.91270175
C	-3.04186004	-2.31060877	0.22834774
C	-1.78305300	-0.64929450	-2.47517299
C	-0.76636445	-1.66428144	-2.05050732
C	0.13689003	-1.49084804	-1.03063483
N	0.72726231	-2.68746138	-0.72003441
C	0.18275501	-3.68150320	-1.49329220
C	-0.75832604	-3.07170978	-2.36329481
C	0.42758707	-5.05979752	-1.49800624
C	-0.28992012	-5.82796679	-2.39934306
C	-1.22446600	-5.24266669	-3.28253447
C	-1.46462882	-3.87907192	-3.27442841
C	-3.69179557	-3.66595317	0.52386927
O	-2.24130857	-1.83538004	1.03149454
N	-4.89714566	-3.89462968	-0.25975820
C	-6.08664837	-3.23455109	-0.16807938
C	-6.16596325	-1.98374279	0.71759132
O	-7.06749941	-3.59160379	-0.80416637
C	-7.37435543	-2.07526924	1.68236201
C	-8.52910348	-1.43122976	0.90866795
C	-7.84201519	-0.54473472	-0.11928534
N	-6.51009351	-0.83716007	-0.10459178
C	-2.69760839	-4.80562963	0.21544125
C	-1.55623205	-5.01491279	1.16307725
N	-0.65083302	-4.07364438	1.59265820

C	0.31311437	-4.72089024	2.29239422
N	0.09607883	-6.01970226	2.34652851
C	-1.06964599	-6.20696681	1.64628693
O	-8.36613043	0.28857622	-0.84148070
O	-1.91657617	3.33341794	0.51020777
C	-1.26267188	6.14682212	-1.31981143
C	0.06259888	6.80472887	-0.99918281
C	0.13545090	7.78184641	-0.00075386
C	1.32123526	8.45101776	0.27897011
C	2.48064700	8.13235786	-0.42937941
C	2.43430538	7.15754209	-1.42768070
C	1.23162262	6.51440012	-1.71153165
O	3.61969217	8.79942770	-0.10122789
C	1.97797730	4.05535407	2.12054568
C	2.08229974	5.58378827	2.05986684
O	0.39195541	1.25988248	0.82589894
C	1.05101408	6.25435204	2.96604664
C	3.50051429	6.02509965	2.41799983
C	-0.54438006	-0.52351076	3.57638932
C	-0.57918200	-1.82100204	4.39666668
C	-0.13829385	-1.60166389	5.84581207
C	-1.98957162	-2.41149996	4.36404661
O	1.26674694	-1.78077673	1.82636484
C	3.79321748	0.93872130	-0.01348310
C	4.60150111	0.82454591	-1.30941803
C	3.75566111	0.62099327	-2.56220939
N	2.91179707	-0.56834478	-2.53788571
C	3.39341674	-1.77131195	-2.98503120
N	2.43024438	-2.63426202	-3.47211771
N	4.66515356	-2.01510171	-2.96370351
O	5.74957299	-0.49980205	1.48924412
C	3.91388079	-3.31643605	0.08728575
C	4.71657805	-4.54254261	-0.34353745
C	5.85936240	-4.58238775	0.67572246
C	6.21270505	-3.09693399	0.87378109
C	7.37119984	-2.67481562	-0.03621616
O	8.52457621	-2.87614465	0.34286338
N	7.04031673	-2.16469572	-1.23498569
C	8.03048452	-1.78716289	-2.22997621
C	7.85087229	-0.33962958	-2.67218957
H	-6.04544419	4.90727961	-1.01889557
H	-5.48280045	3.11772980	0.26696838
H	-6.37109664	2.11835224	-0.90853594
H	-4.80540466	2.78567415	-2.69438018
H	-2.23520312	3.14846587	-2.49001181
H	-0.37482883	4.33865368	-2.09107404
H	0.95592064	4.46358549	-0.11607459
H	-0.16350166	3.86971578	2.45430313
H	0.87059236	2.12047093	3.82197752
H	1.43646330	-0.02835060	4.28970671
H	3.02553274	0.76899154	2.36722907

H	2.83483367	-1.00876894	0.06404260
H	-2.96991780	1.98178871	-0.55117487
H	-2.23017975	-0.07749510	-0.44150834
H	-3.99724683	-2.16914365	-1.57618117
H	-1.32356769	0.31563957	-2.71563684
H	-2.33213893	-0.98177627	-3.36289405
H	0.36883448	-0.60210329	-0.45260269
H	1.28106861	-2.80406995	0.12093833
H	1.13152047	-5.50456191	-0.79949107
H	-0.13605352	-6.90208474	-2.42505281
H	-1.76600909	-5.87869102	-3.97557073
H	-2.19160669	-3.44124896	-3.95323419
H	-3.91608599	-3.66851501	1.59657802
H	-4.92878785	-4.72251139	-0.84666645
H	-5.24042871	-1.79935000	1.26617771
H	-7.14400473	-1.49466357	2.57834816
H	-7.57513665	-3.10461027	1.98239516
H	-9.11722806	-2.17246929	0.36076876
H	-9.20662377	-0.84279829	1.52974208
H	-5.93297159	-0.53256204	-0.88655121
H	-3.26736238	-5.74099376	0.22058838
H	-2.32315694	-4.66630498	-0.80770239
H	-0.72007981	-3.06574164	1.46290030
H	1.14062639	-4.18869227	2.74169779
H	-1.49892961	-7.19040103	1.50389646
H	-1.63734326	6.51142953	-2.28365864
H	-2.00567818	6.42423731	-0.56975322
H	-0.75715883	8.02805517	0.56861802
H	1.36868794	9.21036378	1.05318756
H	3.33175515	6.90892213	-1.98789919
H	1.21696441	5.78200272	-2.51567462
H	4.35320365	8.48413003	-0.65126031
H	2.23031157	3.72413469	3.13426349
H	2.72171540	3.60584246	1.44747431
H	1.89127550	5.91077477	1.03084360
H	1.20930091	7.33690169	2.98916659
H	0.02765729	6.08161578	2.61523997
H	1.13349477	5.87554580	3.99248972
H	3.60924093	7.10606050	2.28110175
H	4.24200663	5.52749873	1.78373266
H	3.73136086	5.78606436	3.46291634
H	-1.13313183	0.23846484	4.10427406
H	-1.01078526	-0.68328204	2.59942038
H	0.10381567	-2.53833550	3.92744345
H	-0.20981133	-2.53574907	6.41233802
H	0.89494793	-1.25019689	5.92903980
H	-0.78641359	-0.86329849	6.33350066
H	-2.02435984	-3.37017456	4.89264458
H	-2.32435762	-2.56539982	3.33408902
H	-2.69718461	-1.73091673	4.85448448
H	2.83270192	1.43892082	-0.19385153

H	4.35788047	1.54499316	0.70479387
H	5.17412781	1.74796268	-1.45474845
H	5.33947978	0.01900524	-1.22985939
H	3.08750141	1.47869131	-2.68622631
H	4.41411788	0.57529695	-3.43784204
H	1.92001175	-0.41548762	-2.66748035
H	2.62962068	-3.62024473	-3.35148912
H	1.46318688	-2.41056264	-3.25816417
H	4.84421651	-2.92421886	-3.39180219
H	3.36688128	-2.87126636	-0.74513590
H	3.21130790	-3.56158284	0.89562118
H	4.11141629	-5.45092075	-0.34966409
H	5.11030798	-4.37849203	-1.35248725
H	6.72246409	-5.16537787	0.34798328
H	5.50374190	-4.99814612	1.62325274
H	6.53965140	-2.87802636	1.89261719
H	6.06151573	-2.05643022	-1.51636849
H	9.01259251	-1.94785279	-1.78192306
H	7.94342830	-2.45574088	-3.09484045
H	8.59603646	-0.07390853	-3.42765882
H	6.85354505	-0.20139949	-3.10165225
H	7.95901839	0.33840325	-1.82003367

Cartesian coordination of OTA optimized using a M06-2X functional together with the 6−31G(d,p) basis set in Ångström. The geometry shown below was the most stable among 3 structures optimized from different initial configurations. $E_{(\mathrm{RM062X})}$ = –1738.84706041; Sum of electronic and thermal Enthalpies = –1738.463617.

C	-0.86696660	0.43713625	-0.24117245
C	-1.47989815	1.68343832	-0.32469554
C	-2.85955408	1.82318690	-0.26353511
C	-3.68188390	0.71651391	-0.08716770
C	-3.07747154	-0.54641709	0.00202763
C	-1.67719210	-0.70540331	-0.09919925
C	-5.18028718	0.78846594	-0.01036867
C	-5.71693095	-0.34261364	0.84693855
O	-5.21635869	-1.61813654	0.36336968
C	-3.91769452	-1.75589304	0.13106499
C	0.63578868	0.44645884	-0.33211207
N	1.28919663	-0.72923869	-0.21995421
O	1.23937011	1.50698927	-0.49458065
O	-1.12095906	-1.92075295	-0.06389645
O	-3.46235664	-2.88792296	0.00690925
C	-7.22499129	-0.44827856	0.83155014
Cl	-3.54983065	3.41990211	-0.41689001
C	2.73445667	-0.73636124	-0.30618180
C	3.41315685	-0.21936235	0.97788085
C	3.23917386	-2.12042854	-0.67653397
O	2.38325917	-2.78506366	-1.46221471
O	4.30200049	-2.56876071	-0.32347727
C	4.77751859	0.37170149	0.71685505
C	5.94845569	-0.25451045	1.14476488
C	7.19231930	0.32128602	0.89218571
C	7.27789255	1.52822247	0.20147793
C	6.11301256	2.15868582	-0.23442794
C	4.87207085	1.58378920	0.02451153
H	-0.84199924	2.55151489	-0.44758741
H	-5.49888294	1.74130301	0.41782973
H	-5.60396130	0.72515017	-1.02105514
H	-5.34772277	-0.23019219	1.87273451
H	0.76990649	-1.59200320	-0.12673959
H	-1.86075911	-2.58527890	-0.04616143
H	-7.58317120	-0.58963951	-0.19117307
H	-7.55318162	-1.29033074	1.44323854
H	-7.66035525	0.46851033	1.23449825
H	3.01740617	-0.07153990	-1.13406902
H	2.75954002	0.55872160	1.38115491
H	3.47135588	-1.02936662	1.70997545
H	2.77702761	-3.64898639	-1.66743423
H	5.88091431	-1.20242456	1.67033763
H	8.09557555	-0.17505672	1.23294026
H	8.24665565	1.97576302	0.00385162
H	6.17187649	3.10025260	-0.77135131
H	3.95702490	2.07141685	-0.30623529