

Supporting Information (SI)

Energetic Bi-diazole 'Transformers' toward High Energy Thermostable Energetic Compounds

Jingwei Meng^a, Teng Fei^{a}, Jinxiong Cai^a, Qi Lai^a, Jinya Zhang^a, Siping Pang^{a*} and Chunlin He^{a,b,c*}*

^a Experimental Center of Advanced Materials, School of Materials Science & Engineering, Beijing Institute of Technology, Beijing, 10081 (China).

^b State Key Laboratory of Explosion Science and Technology, Beijing Institute of Technology, Beijing, 10081 (China).

^c Chongqing Innovation Center, Beijing Institute of Technology, Chongqing 401120, China.

*Email: feiteng@bit.edu.cn (T. Fei); pangsp@bit.edu.cn (S. Pang); chunlinhe@bit.edu.cn (C. He).

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1. Experimental section

1.1 General methods

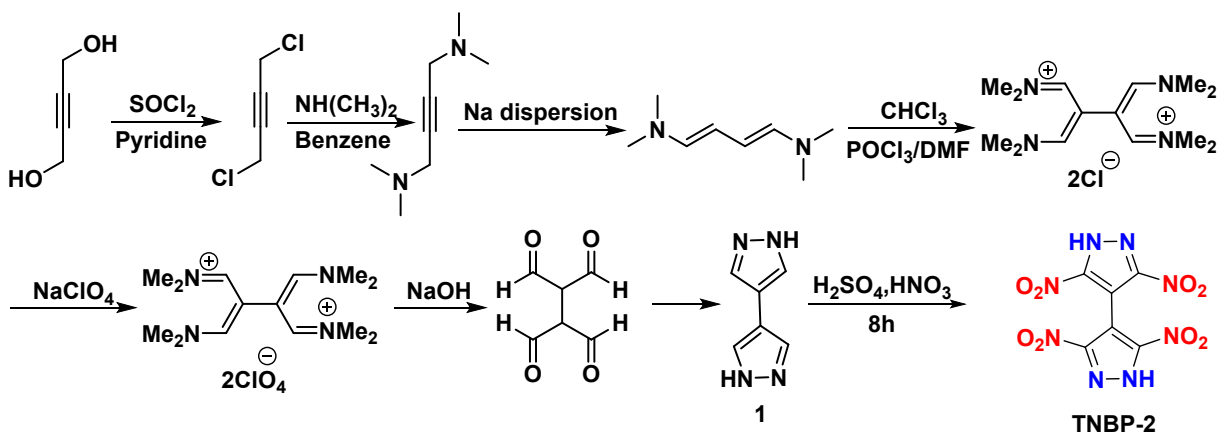
All reagents were purchased from Energy Chemical of analytical grade and used without further purification. The ^1H NMR and ^{13}C NMR spectra were recorded on Bruker 400 MHz spectrometers at 25 °C. Chemical shifts were reported relative to Me_4Si as external standards. Infrared spectra (IR) were recorded on a Perkin Elmer Spectrum BX FT-IR instrument. Elemental analyses (C, H, N) were carried out on a Vario EL III Analyzer. Melting and decomposition (onset) points were recorded on a differential scanning calorimeter (TA Discovery DSC25) at a scan rate of 10 °C min^{-1} . The sensitivities to impact (IS) and friction (FS) were determined according to BAM standards.

1.2 Safety precautions

Although none of the energetic materials described herein have exploded or detonated in the course of this research, they are potentially explosive energetic materials that may be sensitive to impact and friction. Appropriate safety precautions should be taken at all times when handling these materials.

1.3 Preparation of 4,4'-bipyrazole (1), TNBP-2, and DATNBP-2

Synthetic route of 4,4'-bipyrazole (1) [1] and TNBP-2 according to the reported method (Scheme 1) are provided in this section.



Synthesis of 4,4'-bipyrazole (1): The precursor compound 4,4'-bipyrazole was synthesized according to the reported method¹. The 1,4-bis(dimethylamino)butene was prepared from 1,4-dichloro-2-butyne using SOCl_2 as a reagent, and its rearrangement into the conjugated cis-trans-butadiene over Na metal dispersion and the subsequent Vilsmeier-Haack-Arnold formylation providing symmetric perchlorate salt. The latter was hydrolyzed to bis-dialdehyde and then

converted into the 4,4-bipyrazole (1). ^1H NMR(d_6 -DMSO): δ 7.79, 12.76 (s,2H) ppm; ^{13}C NMR(d_6 -DMSO): δ 113.10, 130.76 ppm. Elemental analysis of $\text{C}_6\text{H}_6\text{N}_4$ (134.14): calcd: C,53.72; H,4.51; N,41.77%; found: C52.93 H4.76, N42.31%.

Synthesis of 3,3',5,5'-tetranitro-4,4'-bipyrazole (TNBP-2): Fuming HNO_3 (2.33 mL, 98%) was added to a warm solution of 1 (0.31 g, 2.3 mmol) in 98% H_2SO_4 (14 mL). The mixture was placed into a pre-heated oil bath and the clear solution formed was stirred at 100°C (bath temperature) for 8 h. After cooling, the mixture containing a colorless solid reaction product was poured into crushed ice and left overnight at $5\text{--}10^\circ\text{C}$. The crystalline deposit was filtered (0.706 g, 91%), washed with 40 mL of ice water and dried. $T_d(\text{onset})$: 298°C . ^1H NMR(d_6 -DMSO): δ 9.46(s,2H) ppm; ^{13}C NMR(d_6 -DMSO): δ 101.04, 149.86 ppm. IR(KBr): 3740, 3208, 2967, 1567, 1519, 1482, 1416, 1348, 1320, 1274, 1207, 1018, 994, 842, 758, 744, 712, 675, 635, 580, $518\tilde{\text{v}}\text{cm}^{-1}$. Elemental analysis of $\text{C}_6\text{H}_2\text{N}_8\text{O}_8$ (314): calcd: C22.94, H0.64, N35.67%; found: C23.06, H0.79, N35.72%.

Synthesis of 1,1'-diamine-3,3',5,5'-tetranitro-4,4'-bipyrazole (DATNBP-2): A mixture of TNBP-2(0.34 g, 1.08 mmol) and 1,8-diazabicycloundec-7-ene (DBU) (0.33 g, 2.16 mmol) in anhydrous acetonitrile (15 mL) was stirred at the ambient temperature for 0.5 h. And then fresh O-p-tolylsulfonylhydroxylamine (2.3 equiv, 9.2 mmol) in anhydrous dichloromethane solution (30 mL) was added with portions in 5 min. The mixture was stirred for 2.5 h, and the solvent was removed under vacuum. The DATNBP-2 was obtained by flash chromatography as a yellow solid (0.32 g, 86 %). $T_d(\text{onset})$: 305°C . ^1H NMR(d_6 -DMSO): δ 8.03(s,2H), 7.43(s,2H) ppm; ^{13}C NMR(d_6 -DMSO): δ 100.50, 140.07, 145.53 ppm. IR(KBr): 3338.29, 3273.72, 1549.05, 1488.96, 1428.07, 1377.52, 1324.73, 1132.00, 1103.58, 1011.12, 868.47, 831.58, 730.06, 627.53, 612.90 $\tilde{\text{v}}\text{cm}^{-1}$. Elemental analysis of $\text{C}_6\text{H}_4\text{N}_{10}\text{O}_8$ (344.02): calcd: C20.94, H1.17, N40.70%; found: C20.65, H2.23, N39.03%.

2. X-ray crystallography details

2.1 Single crystal preparation and crystallographic data

The crystal of **DATNBP-2** suitable for single-crystal XRD was obtained from slow evaporation of its petroleum ether and ethyl acetate solution at room temperature. Crystallographic data of compounds in this study are provided in this section.

2.2 Hydrogen bond interaction

The strengths of the relevant intra-/intermolecular interaction were evaluated by the integrated value of the crystal orbital Hamilton population (COHP) below the Fermi energy, using a recently developed High Accuracy Atomistic Simulation for Energetic Materials (HASEM) package [2,3]. The generalized gradient approximation (GGA) is used for the exchange-correlation function in the Perdew-Burke-Ernzerhof (PBE) form.

Table S1 Crystallographic data for **DATNBP-2**.

| Compound | DATNBP-2 | DATNBP-2 |
|--|--|--|
| CCDC No. | 2268272 | 2206102 |
| Formula | C ₆ H ₄ N ₁₀ O ₈ | C ₆ H ₄ N ₁₀ O ₈ |
| M _w | 344.19 | 344.19 |
| Crystal system | orthorhombic | orthorhombic |
| Space group | Pbca | Pbca |
| a[Å] | 12.899(6) | 12.8197(17) |
| b[Å] | 6.244(2) | 6.1427(7) |
| c[Å] | 30.293(10) | 30.168(4) |
| α[°] | 90 | 90 |
| β[°] | 90 | 90 |
| γ[°] | 90 | 90 |
| V[Å ³] | 2440.0(16) | 2375.7(5) |
| Z | 8 | 8 |
| T[K] | 298K | 170K |
| λ[Å] | 0.71073 | 0.71073 |
| P _{calcd} [g·cm ⁻³] | 1.874 | 1.925 |
| μ[mm ⁻¹] | 0.173 | 0.178 |
| F(000) | 1392.0 | 1392.0 |
| Crystal size/mm ³ | 0.12 × 0.06 × 0.05 | 0.09×0.04×0.03 |
| θ range[°] | 4.148-52.826 | 4.166-52.91 |

| | | |
|---|--------------|--------------|
| Index ranges | -12 ≤ h ≤ 16 | -14 ≤ h ≤ 14 |
| | -7 ≤ k ≤ 7 | -6 ≤ k ≤ 7 |
| | -37 ≤ l ≤ 37 | -36 ≤ l ≤ 3 |
| Data/restraints/ parameters | 2441/16/229 | 2424/24/226 |
| GOF on F2 | 1.021 | 1.053 |
| R[F ² > 2σ(F ²)] | 0.0803 | 0.0839 |
| wR(F ²) | 0.1862 | 0.1863 |

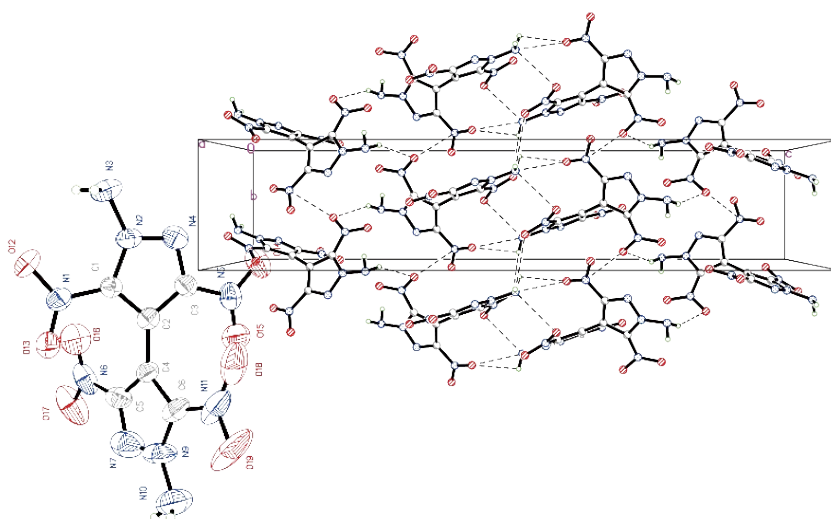


Figure S1 Single-crystal X-ray structures and packing diagram of **DATNBP-2** at 170K

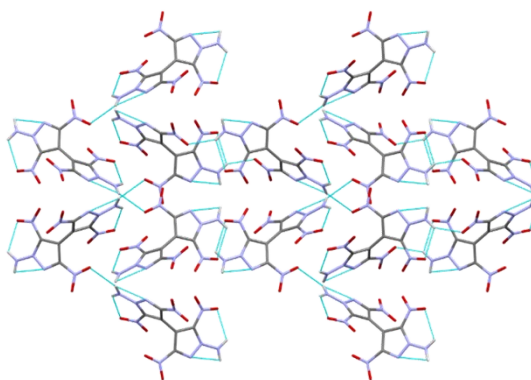


Figure S2 Hydrogen bonds for **DATNBP-2**.

Table S2 Hydrogen bonds for **DATNBP-2**.

| D-H...A | D-H/Å | H...A/Å | D...A/Å | D-H...A/° | Energy/kcal mol ⁻¹ |
|---------------------|-------|---------|-----------|-----------|-------------------------------|
| N3-H3B...O7 | 0.88 | 2.56 | 2.931(7) | 106 | 1.345580175 |
| Intra N3-H3B...O2 | 0.88 | 2.24 | 2.777(6) | 119 | 4.50832775 |
| Intra N10-H10A...N9 | 0.88 | 1.58 | 1.97(2) | 102 | 6.56486332 |
| Intra N10-H10A...O6 | 0.88 | 2.43 | 2.918(13) | 116 | 2.24655391 |
| N10-H10A...O3 | 0.88 | 2.14 | 2.909(10) | 146 | 5.114588295 |

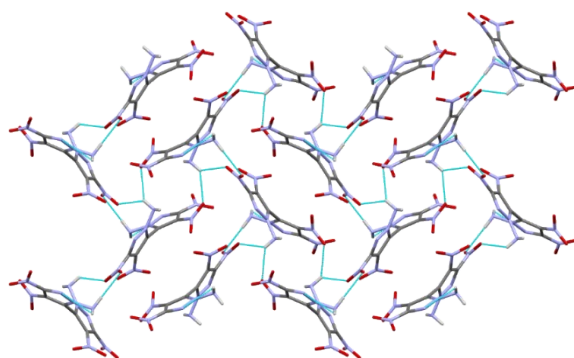


Figure S3 Hydrogen bonds for **DATNBP-1**.

Table S3. Hydrogen bonds for **DATNBP-1**.

| D-H...A | D-H/Å | H...A/Å | D...A/Å | D-H...A/° | Energy/kcal mol ⁻¹ |
|-------------|-------|---------|---------|-----------|-------------------------------|
| N5-H5B...O2 | 0.87 | 2.24 | 2.944 | 120 | 2.046158 |
| N5-H5B...O6 | 0.87 | 2.37 | 3.023 | 133 | 1.14726 |
| N6-H6B...O1 | 0.90 | 2.27 | 3.132 | 160 | 1.396774 |

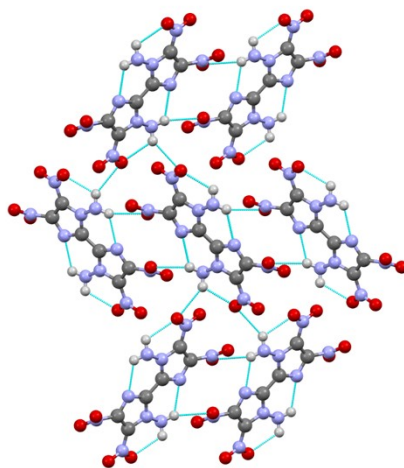


Figure S4 Hydrogen bonds for **DATNBP-1**.

Table S4 Hydrogen bonds for **DATNBP-1**.

| D-H...A | D-H/Å | H...A/Å | D...A/Å | D-H...A/° | Energy/kcal mol ⁻¹ |
|-------------------|-------|---------|---------|-----------|-------------------------------|
| Intra N3-H3B...O1 | 0.86 | 2.24 | 2.759 | 119 | 4.30832775 |

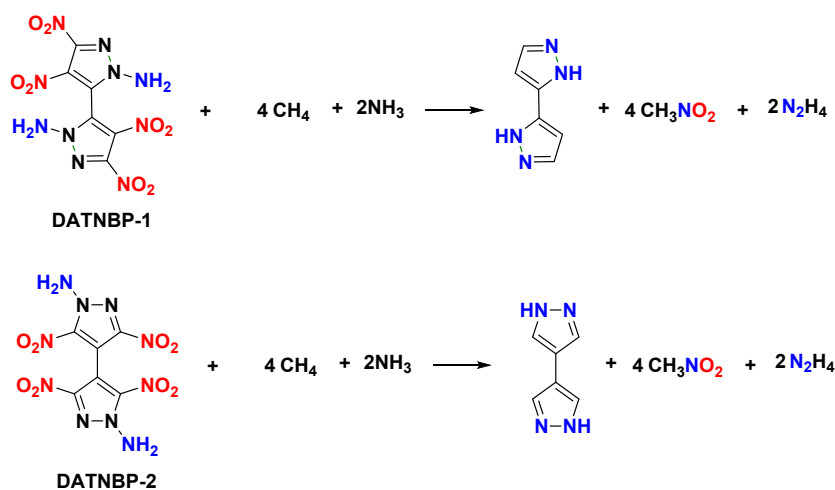
| | | | | | |
|-------------------|------|------|-------|-----|------------|
| N3-H3B...O1 | 0.86 | 2.53 | 3.244 | 141 | 1.64121657 |
| N3-H3A...O4 | 0.86 | 2.42 | 3.166 | 145 | 1.92341630 |
| Intra N3-H3B...O1 | 0.86 | 2.26 | 2.830 | 124 | 4.02853527 |

3. Heat of formation

Theoretical calculations were performed by using the Gaussian09 program and Multiwfn software [4,5]. Gas phase heats of formation of the title compounds were computed based on an isodesmic reaction (Scheme S2). The geometric optimization and frequency analyses of the structures employed B3LYP/6-31++G** level, Zero-point energies (ZPE), and total energy(E_0) were calculated at the M062X/6-311++(d,p) level.

The heat of formation was obtained by using the isodesmic reaction approach. Atomization energies were obtained by employing the G2 ab initio method. All of the optimized structures were characterized to be true local energy minima on the potential energy surface without imaginary frequencies. The heats of formation in the solid state were further obtained by employing Trouton's rule according to equation 1[6].

$$\Delta H_{Sub} = 188/J \text{ mol}^{-1} K^{-1} \times (1) \quad (1)$$



Scheme S2 Isodesmic reactions for **DATNBP-1**, **DATNBP-2**.

Table S5 The zero point energy (ZPE), temperature correction coefficient (H_T), total energy (E_0), heat of formation (HOF) of **DATNBP-2**

| Compound | ZPE (a.u) | H_T (a.u) | E_0 (a.u) | HOF (kJ mol ⁻¹) |
|---------------------------------|-----------|-------------|--------------|-----------------------------|
| DATNBP-1 | 0.165464 | 0.18725900 | -1376.857830 | 457.5 |
| DATNBP-2 | 0.165038 | 0.18662000 | -1376.913937 | 477.3 |
| CH ₄ | 0.044558 | 0.00381000 | -40.4966719 | -74.6 |
| NH ₃ | 0.034252 | 0.00366528 | -56.5405858 | -45.9 |
| bipyrazole | 0.069995 | 0.00850752 | -448.8305749 | 286.8 |
| CH ₃ NO ₂ | 0.049628 | 0.00531000 | -244.9716281 | -81.0 |
| N ₂ H ₄ | 0.053276 | 0.057481 | -111.8435902 | 110.6 |

4. Stability and theoretical analysis

4.1 Lattice parameter

Lattice parameter of two **DATNBP-1** were analyzing by using VASP (Vienna Ab initio Simulation Package) [7]. The calculations were performed using projected augmented wave (PAW) formalism of the Kohn–Sham density functional theory. Geometry optimization was done using GGA, including van der Waals interaction using DFT-D3.

Table S5 Correlation energy of crystal of **DATNBP-1** and **DATNBP-2**

| Name | Total Energy | Energy of Molecule | Lattice Energy(ev) | Lattice Energy (kJ mol ⁻¹) |
|----------|--------------|--------------------|--------------------|--|
| DATNBI | -388.407881 | -192.58147975 | -1.622460965 | -156.5436329 |
| DATNBP-1 | -772.6030224 | -191.4780852 | -1.672670425 | -161.3881078 |
| DATNBP-2 | -1659.130717 | -205.4989431 | -1.892396546 | -182.5884485 |

4.2 The bond properties of selected bonds in **DATNBP-2**, **DATNBP-1**, and **DATNBI**

The Mayer bond orders, the bond dissociation energy (BDE), and the bond length for C-NO₂ bonds in **DATNBP-2**, **DATNBP-1**, and **DATNBI** are calculated by the Gaussian 09 software and Multiwfn software.

Table S6 The bond properties of selected bonds in **DATNBP-1** and **DATNBP-2**

| | Label | BDE (kcal mol ⁻¹) | Mayer Order | Bond length (Å) |
|----------|---------|-------------------------------|-------------|-----------------|
| DATNBP-2 | C13-N4 | 64.09 | 0.89240660 | 1.44877 |
| | C17-N8 | 65.85 | 0.89771746 | 1.42808 |
| | C20-N16 | 64.09 | 0.89238630 | 1.44877 |
| | C22-N12 | 65.85 | 0.89771741 | 1.42808 |
| DATNBP-1 | C19-N15 | 57.58 | 0.77284767 | 1.45680 |
| | C20-N16 | 64.20 | 0.82748265 | 1.42922 |
| | C23-N17 | 64.20 | 0.82757670 | 1.42874 |
| | C24-N18 | 57.58 | 0.77314367 | 1.45680 |
| DATNBI | C10-N8 | 59.88 | 0.82393386 | 1.43285 |
| | C11-N9 | 57.56 | 0.74622171 | 1.46854 |
| | C24-N22 | 59.88 | 0.82391675 | 1.43286 |
| | C25-N23 | 57.56 | 0.74622720 | 1.46853 |

4.3 The Hirschfeld Surfaces and The Two-dimensional(2D) Fingerprint

To better understand the relationship between structure and mechanical sensitivity, the Hirschfeld surfaces and the two-dimensional(2D) fingerprint are studied (Fig.S5) [8].

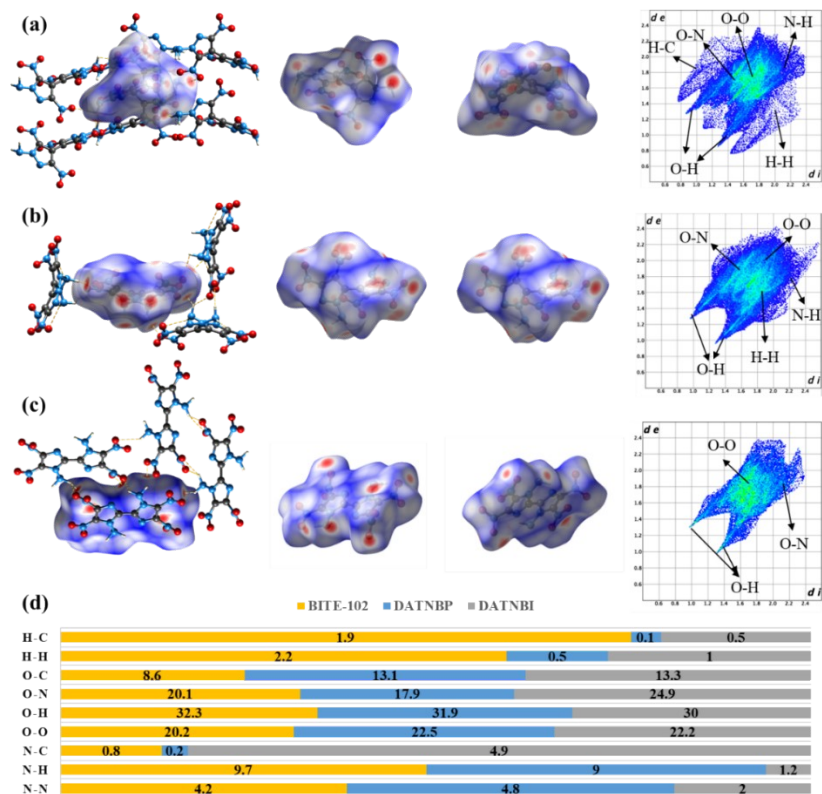


Figure S5 2D fingerprint plots in crystal stacking and Hirschfeld surfaces of **DATNBP-2(a)** and **DATNBP-2(b)**, and the individual atomic contact percentage contribution of two **DATNBP-1(c)**.

5. Spectrum Analysis and DSC plots

^1H , ^{13}C NMR, and IR spectra of compounds in this study are provided in this section. The thermal stability of DATNBP-2 was tested using the differential scanning calorimeter (DSC) method and the DSC plots are shown in Fig. S13.

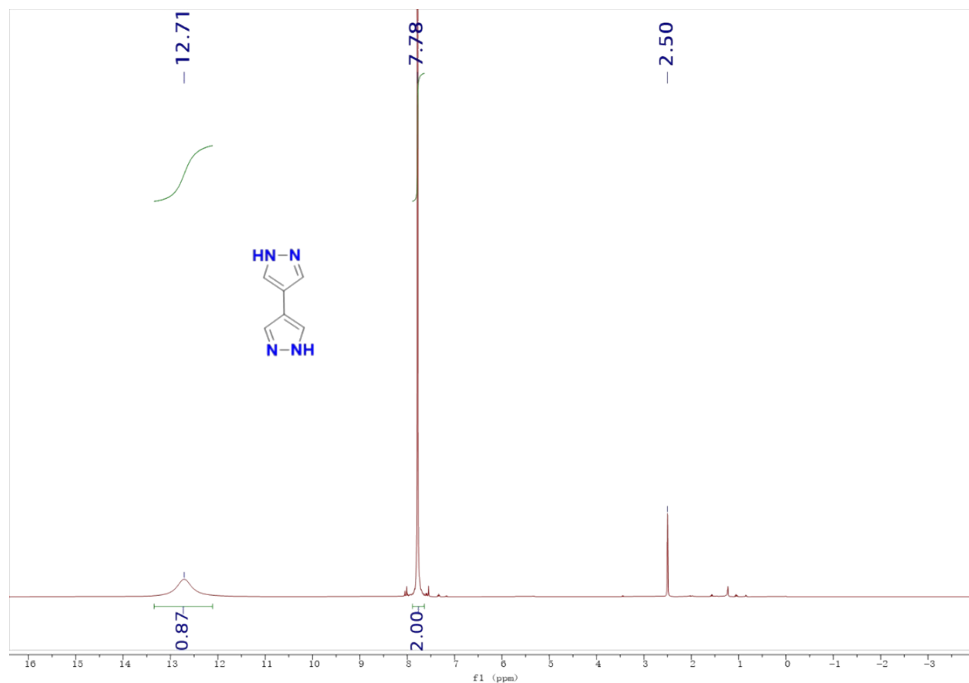


Figure S6 ^1H NMR spectrum of **1** in d_6 -DMSO.

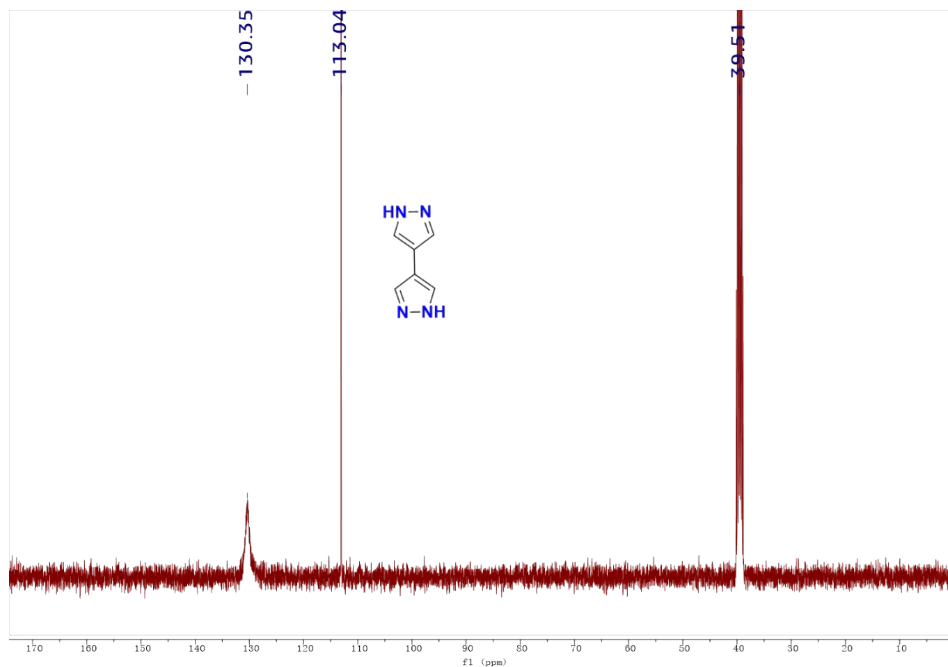


Figure S7 ^{13}C NMR spectrum of **1** in d_6 -DMSO.

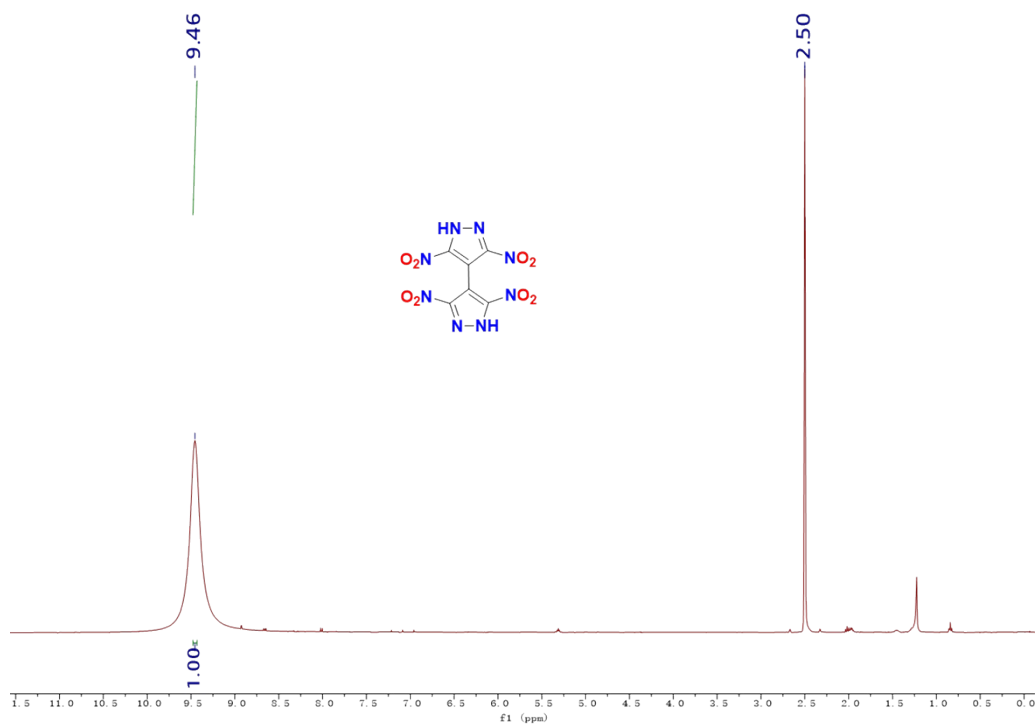


Figure S8 ^1H NMR spectrum of TNBP-2 in d_6 -DMSO.

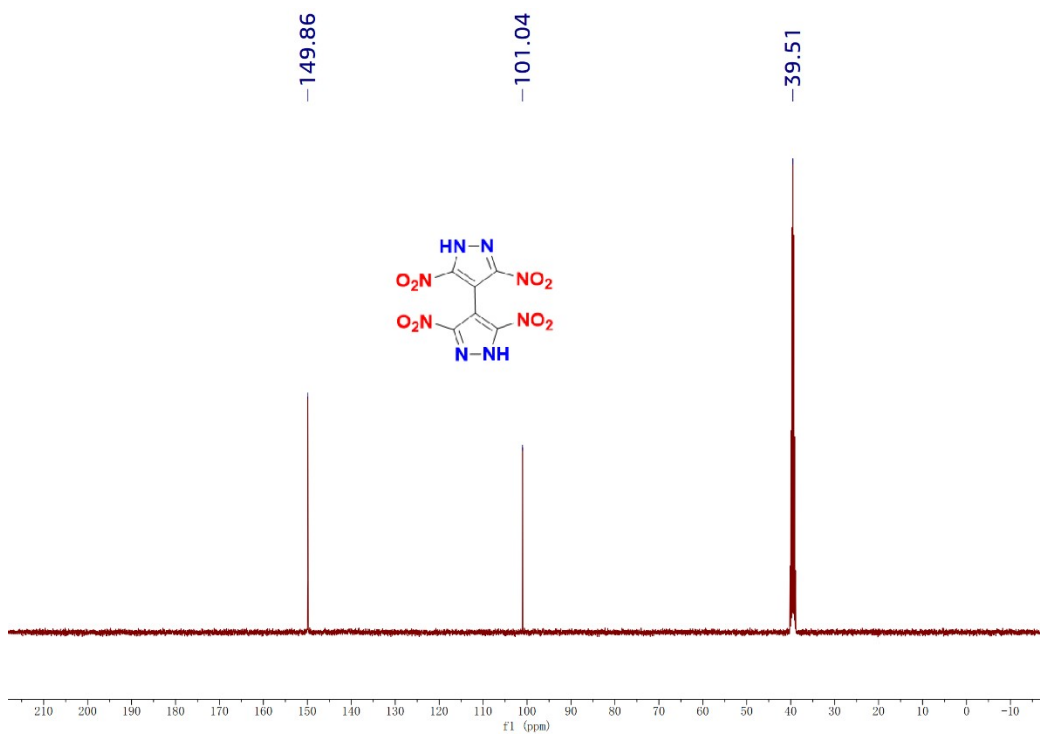


Figure S9 ^{13}C NMR spectrum of TNBP-2 in d_6 -DMSO.

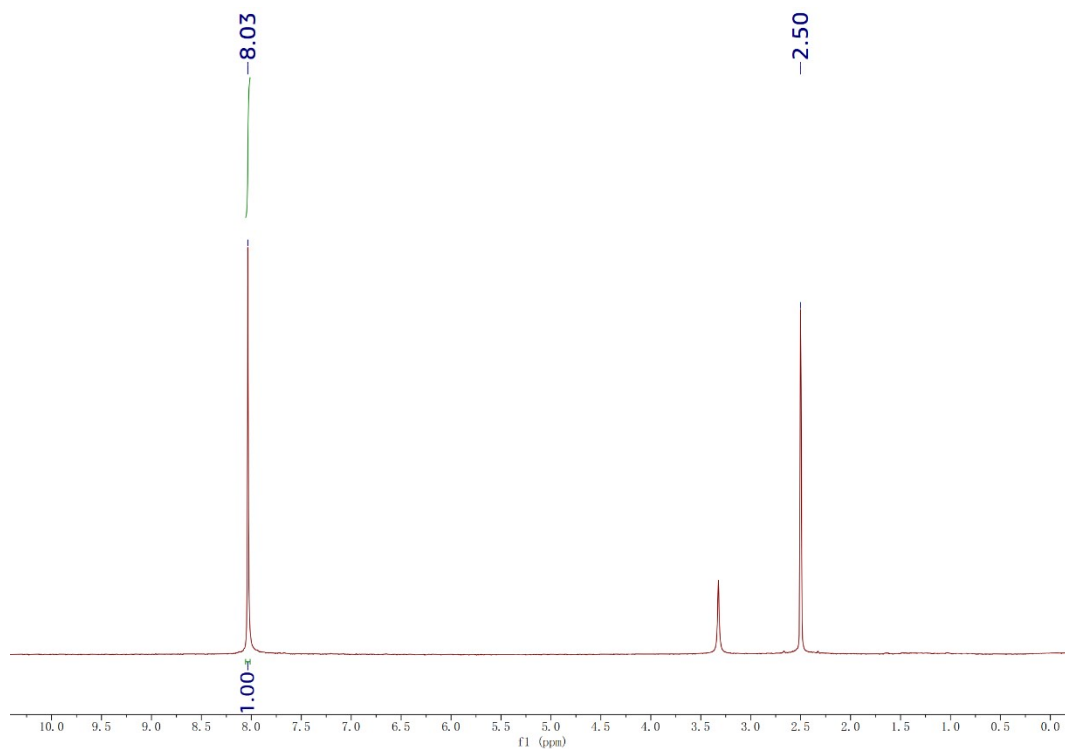


Figure S10 ^1H NMR spectrum of DATNBP-2 in d_6 -DMSO.

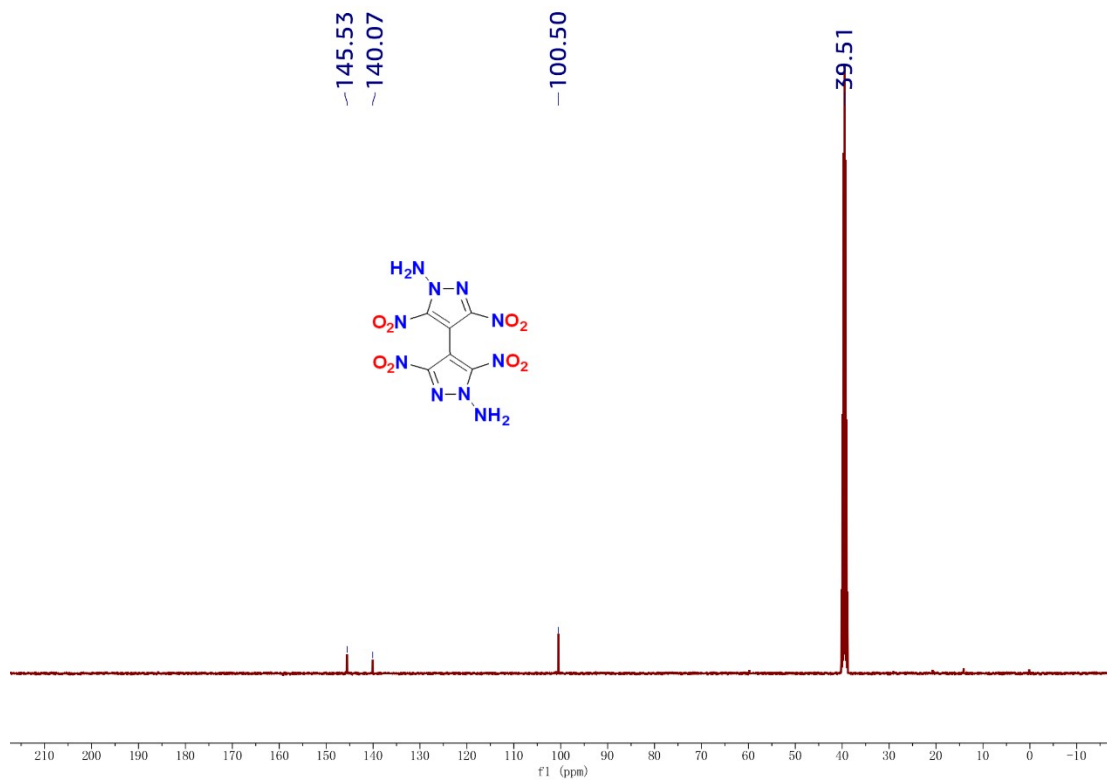


Figure 11 ^{13}C NMR spectrum of DATNBP-2 in d_6 -DMSO.

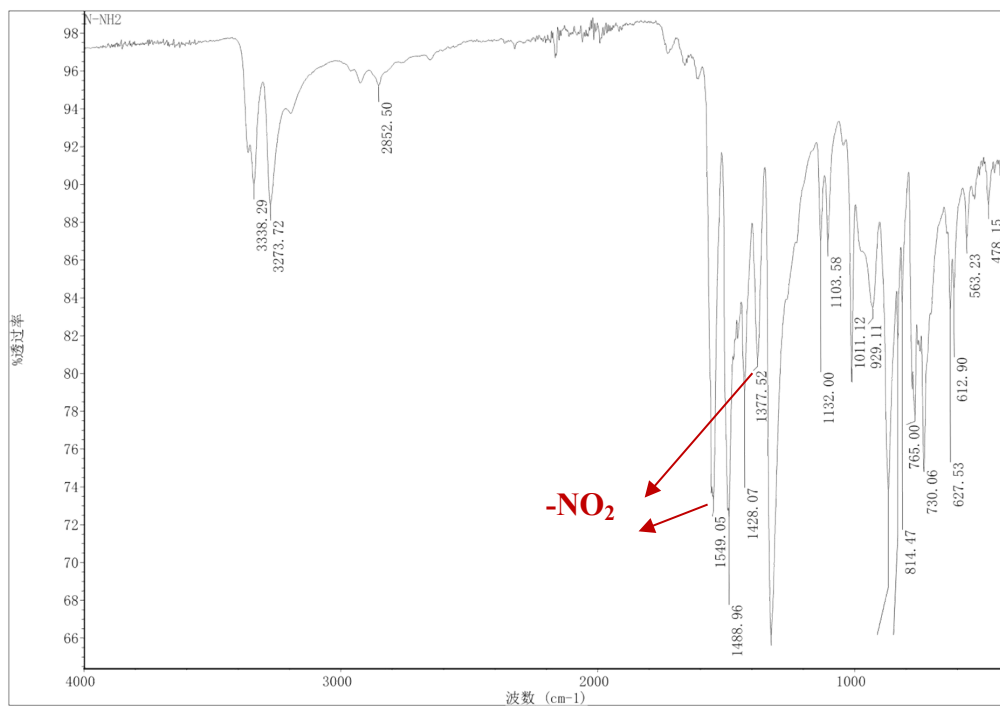


Figure S12 IR spectrum of compound **DATNBP-2**.

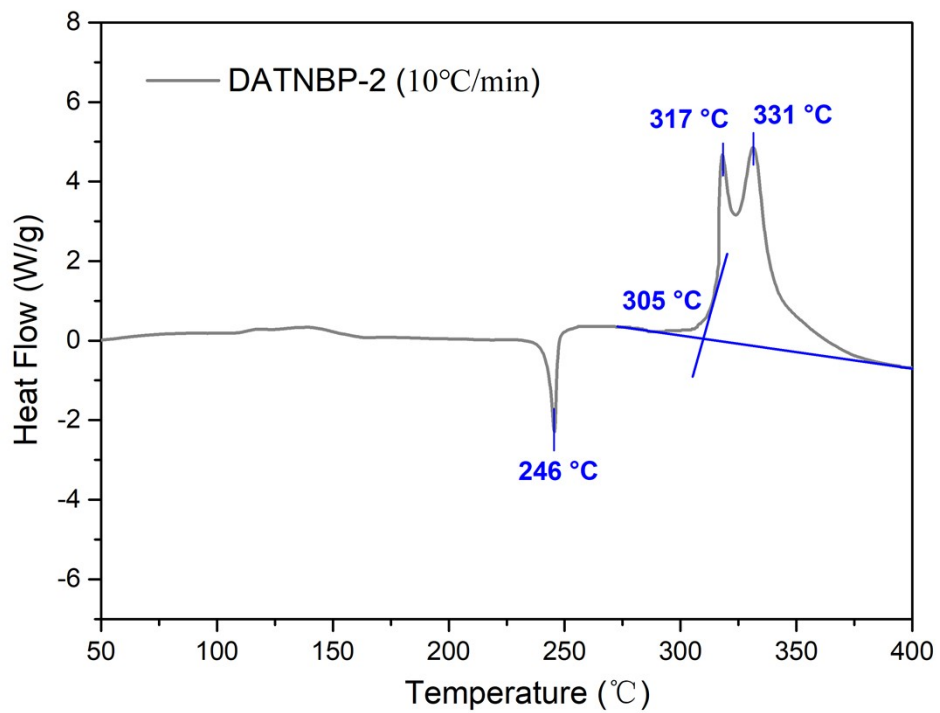
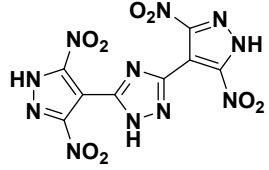
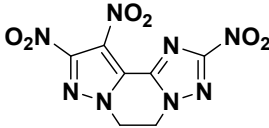
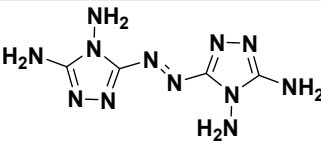
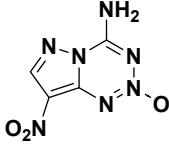
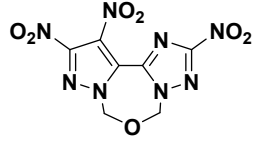
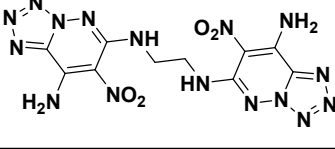
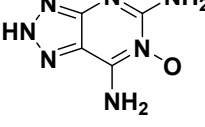
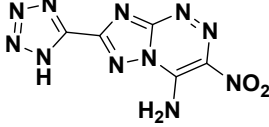
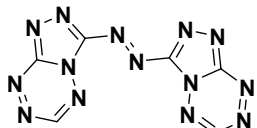
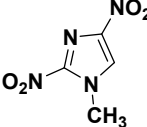
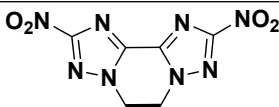
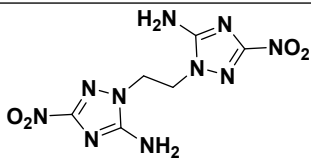
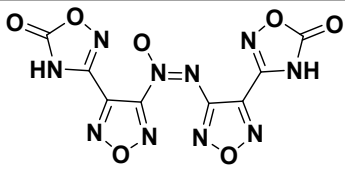
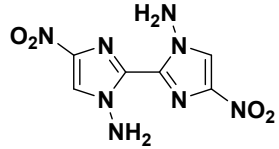
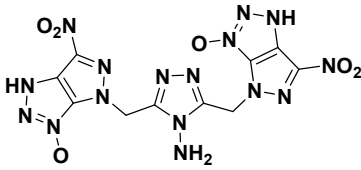
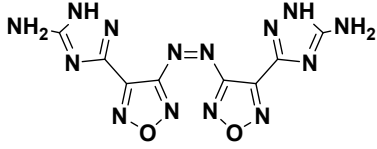
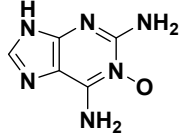
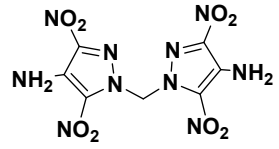
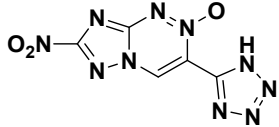


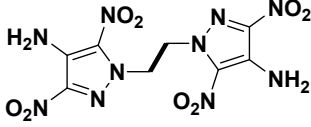
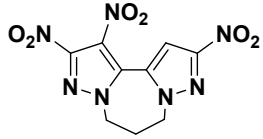
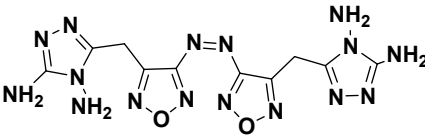
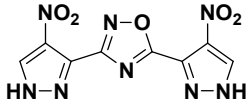
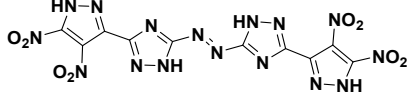
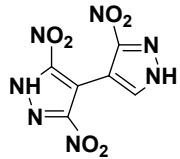
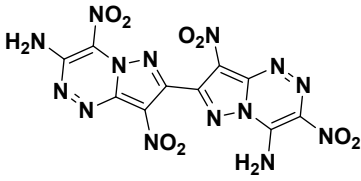
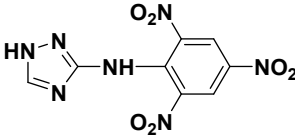
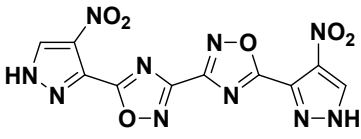
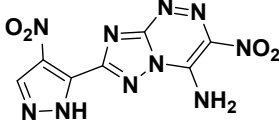
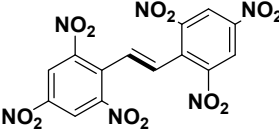
Figure S13 DSC curve of **DATNBP-2**


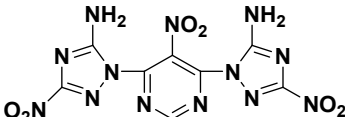
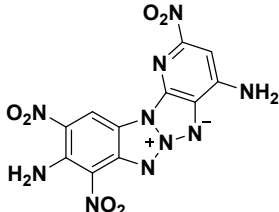
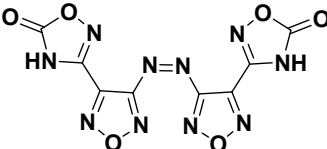
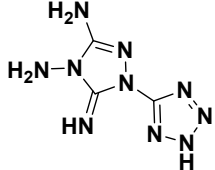
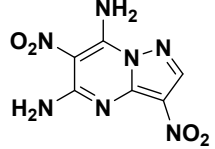
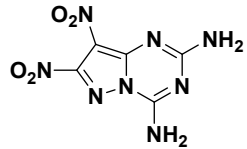
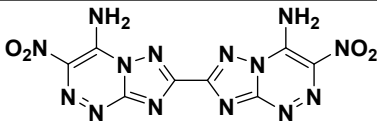
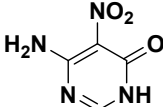
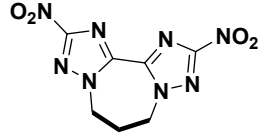
6. 90 neutral energetic compounds with a $T_d > 300^\circ\text{C}$ were collected and summarized

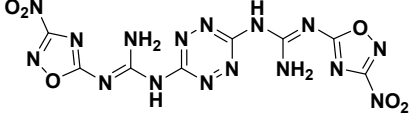
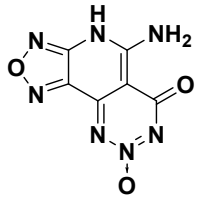
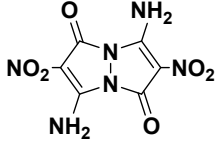
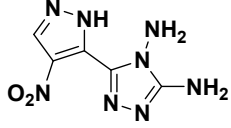
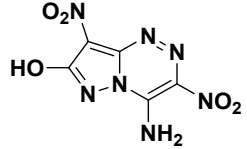
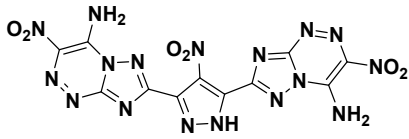
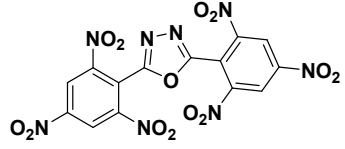
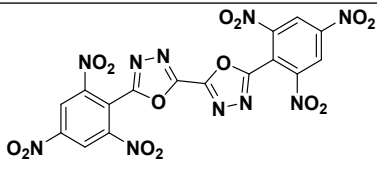
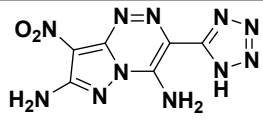
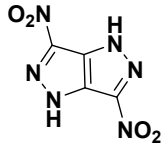
Table S7 90 neutral energetic compounds with a $T_d > 300^\circ\text{C}$ were collected and summarized

| Compound | D ($\text{g}\cdot\text{cm}^{-3}$) | T_d ($^\circ\text{C}$) | D ($\text{m}\cdot\text{s}^{-1}$) | P (GPa) | IS (J) | FS (N) | Ref. |
|---|--|-------------------------------|---|--------------|-------------|-------------|------|
|  | 1.860 | 300 | 8813 | 33.08 | 22 | 300 | 9 |
|  | 1.816 | 302 | 8285 | 29.2 | 23 | >360 | 10 |
|  | 1.683 | 302 | 8742 | 26.9 | >40 | >360 | 11 |
|  | 1.874 | 302 | 8935 | 34.5 | >20 | >360 | 12 |
|  | 1.825 | 303 | 8304 | 29.8 | 21 | >360 | 10 |
|  | 1.840 | 303 | 8809 | 29.3 | 19 | 288 | 13 |
|  | 1.72 | 303 | 7854 | 21.5 | >40 | >360 | 14 |
|  | 1.82 | 305 | 8312 | 27 | >80 | >360 | 15 |
|  | 1.91 | 305 | 9200 | 34.8 | 16 | >360 | 16 |

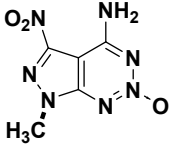
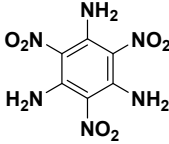
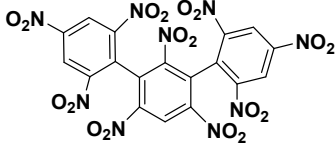
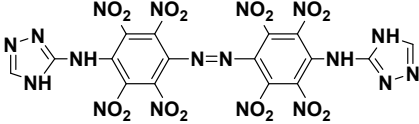
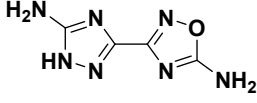
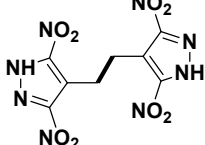
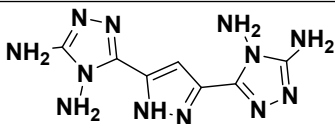
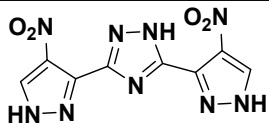
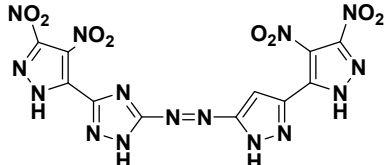
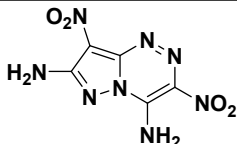
| | | | | | | | |
|---|-------|-----|------|-------|-----|------|----|
|  | 1.613 | 305 | 7244 | 21.75 | 23 | 360 | 17 |
|  | 1.733 | 307 | 7838 | 24.1 | 22 | >360 | 18 |
|  | 1.72 | 307 | 8069 | 24.5 | >40 | 360 | 19 |
|  | 1.95 | 307 | 8844 | 34.4 | 13 | 160 | 20 |
|  | 1.75 | 308 | 7939 | 25.6 | >40 | - | 21 |
|  | 1.745 | 308 | 8329 | 27.9 | 18 | 240 | 22 |
|  | 1.79 | 309 | 8458 | 26.2 | >40 | 360 | 23 |
|  | 1.66 | 309 | 6609 | 13.9 | >40 | >360 | 14 |
|  | 1.802 | 310 | 8332 | 29.6 | 11 | >360 | 24 |
|  | 1.81 | 310 | 9047 | 34.0 | 25 | 360 | 25 |

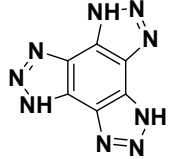
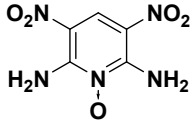
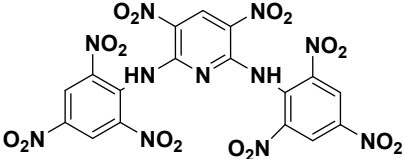
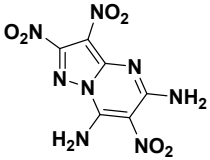
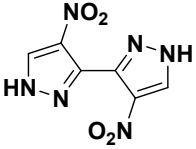

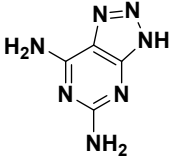
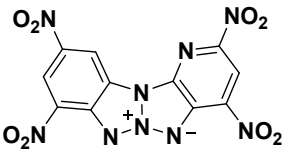
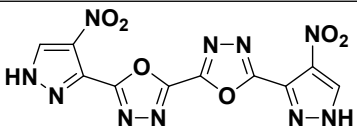
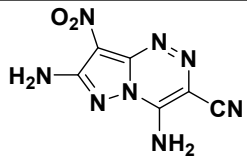
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|---|-------|-----|------|-------|-----|------|----|
|  | 1.77 | 311 | 8189 | 27.9 | >40 | >360 | 26 |
|  | 1.69 | 312 | 7698 | 23.4 | 32 | >360 | 10 |
|  | 1.68 | 313 | 7756 | 23.6 | >40 | >360 | 27 |
|  | 1.77 | 314 | 8027 | 26.4 | >40 | >360 | 28 |
|  | 1.882 | 314 | 8889 | 34.3 | 18 | 240 | 29 |
|  | 1.855 | 314 | 8256 | 28.6 | 20 | >360 | 30 |
|  | 1.85 | 315 | 8572 | 31.4 | >60 | >360 | 31 |
|  | 1.94 | 316 | 7850 | 31.3 | 40 | 360 | 32 |
|  | 1.782 | 317 | 7991 | 25.2 | >40 | >360 | 28 |
|  | 1.79 | 317 | 8165 | 26.37 | >40 | >360 | 33 |
|  | 1.74 | 318 | 7612 | 24.3 | 5 | 240 | 33 |

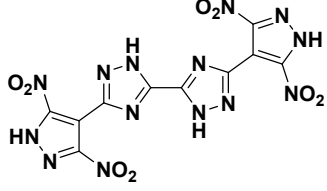
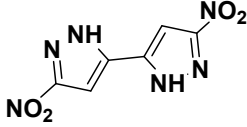
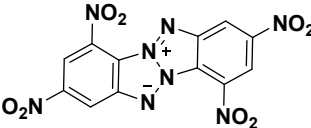
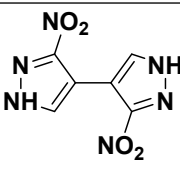
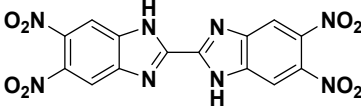
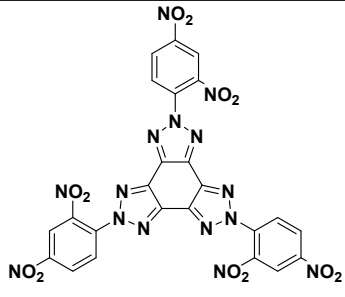
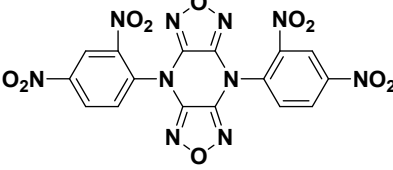
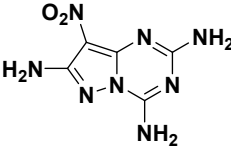
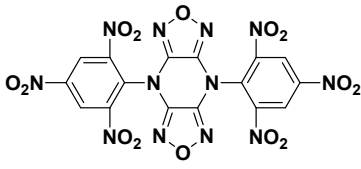
| | | | | | | | |
|---|-------|-----|------|-------|-----|------|----|
|  | 1.71 | 319 | 6988 | 21.4 | >40 | >360 | 34 |
|  | 1.84 | 320 | 8120 | - | 50 | - | 35 |
|  | 1.84 | 320 | 7933 | 24.6 | >15 | 360 | 36 |
|  | 1.89 | 322 | 8507 | 30.7 | 16 | 160 | 37 |
|  | 1.685 | 324 | 8423 | 24.16 | >60 | - | 38 |
|  | 1.88 | 325 | 8338 | 30.7 | 40 | 360 | 39 |
|  | 1.825 | 326 | 8551 | 29.8 | 35 | >360 | 40 |
|  | 1.90 | 327 | 8837 | 32.9 | >40 | >360 | 41 |
|  | 1.804 | 328 | 7535 | 19.2 | >40 | >360 | 42 |
|  | 1.634 | 328 | 7336 | 19.7 | 30 | >360 | 18 |

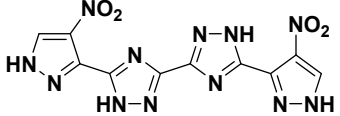
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|---|-------|-----|------|-------|-----|------|----|
|  | 1.812 | 328 | 8002 | 28.52 | >70 | - | 43 |
|  | 1.86 | 329 | 7853 | 24.5 | >40 | - | 44 |
|  | 1.88 | 329 | 7720 | 24.33 | 8.2 | >360 | 45 |
|  | 1.87 | 331 | 9075 | 30.7 | >80 | >360 | 46 |
|  | 1.887 | 332 | 8538 | 30.4 | >40 | >360 | 47 |
|  | 1.85 | 332 | 8476 | 30.24 | >40 | >360 | 33 |
|  | 1.88 | 332 | 7840 | 27.91 | 20 | - | 48 |
|  | 1.84 | 335 | 8030 | 27.3 | 5 | >360 | 49 |
|  | 1.872 | 335 | 8657 | 27.82 | >60 | >360 | 50 |
|  | 1.85 | 336 | 8250 | 27.4 | 15 | 160 | 51 |

| | | | | | | | |
|--|-------|-----|------|-------|-----|------|----|
| | 1.851 | 336 | 8568 | 31.4 | 19 | 240 | 52 |
| | 1.76 | 337 | 7970 | 23.88 | >40 | >360 | 53 |
| | 1.81 | 337 | 8227 | 26.3 | >40 | >360 | 54 |
| | 1.80 | 338 | 8099 | 27.14 | >40 | >360 | 55 |
| | 1.865 | 341 | 8517 | 30.6 | 22 | 352 | 56 |
| | 1.68 | 341 | 7818 | 20.4 | >40 | >360 | 57 |
| | 1.92 | 342 | 8639 | 31.7 | 20 | 360 | 60 |
| | 1.68 | 342 | 8944 | 25.8 | 40 | 360 | 58 |
| | 1.78 | 343 | 7547 | 21.9 | 10 | 240 | 36 |
| | 1.743 | 348 | 7849 | 22.16 | >80 | >360 | 59 |

| | | | | | | | |
|---|-------|-----|------|-------|-----|------|----|
|  | 1.73 | 348 | 8102 | 25 | 18 | >360 | 60 |
|  | 1.93 | 350 | 8176 | 27.72 | 50 | >360 | 71 |
|  | 1.78 | 350 | 7721 | 26.58 | 60 | - | 60 |
|  | 1.97 | 350 | 8320 | 34.1 | 87 | 36 | 61 |
|  | 1.772 | 351 | 7871 | 21.8 | >40 | >360 | 62 |
|  | 1.805 | 351 | 8234 | 28.6 | 10 | 352 | 56 |
|  | 1.78 | 353 | 9275 | 28.7 | >80 | >360 | 63 |
|  | 1.786 | 354 | 7558 | 22.29 | >30 | >360 | 64 |
|  | 1.855 | 354 | 8404 | 29.2 | 19 | 240 | 52 |
|  | 1.90 | 355 | 8727 | 32.6 | >60 | >360 | 65 |

| | | | | | | | |
|---|-------|-----|------|-------|-----|------|----|
|  | 1.77 | 356 | 7160 | 19.4 | 18 | - | 15 |
|  | 1.878 | 358 | 7842 | 27.5 | 15 | >360 | 66 |
|  | 1.76 | 360 | 7757 | 25.1 | 10 | 360 | 71 |
|  | 1.87 | 364 | 8359 | 26.5 | >60 | >360 | 67 |
|  | 1.83 | 365 | 8120 | 26.9 | >40 | >360 | 68 |
|  | 1.82 | 365 | 8528 | 29.4 | 20 | >360 | 60 |
|  | 1.67 | 365 | 7426 | 18.16 | >40 | >360 | 69 |
|  | 1.94 | 366 | 7670 | 24.2 | 9 | >360 | 36 |
|  | 1.81 | 368 | 8054 | 26.53 | >40 | >360 | 55 |
|  | 1.794 | 370 | 7891 | 22.7 | 60 | >360 | 70 |

| | | | | | | | |
|---|-------|-----|------|-------|-----|------|----|
|  | 1.877 | 372 | 8705 | 32.25 | 26 | >360 | 9 |
|  | 1.81 | 376 | 8026 | 26.2 | >40 | >360 | 68 |
|  | 1.64 | 378 | 7250 | 21.0 | 69 | >360 | 71 |
|  | 1.794 | 382 | 7528 | 22.1 | 30 | >360 | 30 |
|  | 1.75 | 394 | 6198 | 14.5 | 15 | >360 | 71 |
|  | 1.69 | 400 | 7032 | 19.9 | 19 | - | 15 |
|  | 1.74 | 405 | 7200 | 23.0 | 16 | 300 | 16 |
|  | 1.78 | 406 | 7789 | 21.8 | >40 | >360 | 72 |
|  | 1.82 | 415 | 7874 | 28.2 | 10 | 240 | 73 |

| | | | | | | | |
|---|-------|-----|------|-------|-----|------|----|
|  | 1.794 | 425 | 7503 | 21.37 | >30 | >360 | 64 |
|---|-------|-----|------|-------|-----|------|----|

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