

行政院國家科學委員會專題研究計畫 成果報告

含鐵、錳硝基化合物之合成及反應性探討及其做為一氧化
氮供給劑與催化一氧化氮轉換之研究(第2年)
研究成果報告(完整版)

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1. Introduction

Dinitrosyl iron complexes (DNICs), the endogenous NO-containing compounds, are known as one of two possible naturally occurring forms for storage and delivery of NO in biological system.¹ In particular, CO has been found to exert similar biological activities to those of NO by cGMP production, p38 mitogen-activated protein kinase activation, and nuclear factor- κ B activation^{2, 3}. Both of CO and NO have also been implicated as mediators of the increased cerebral blood flow in response to elevated brain activity.^{2, 3} DNICs are classified into protein-bound and low-molecular-weight (LMW) DNICs serving as the storage and donor of NO or $\{\text{Fe}(\text{NO})_2\}$ moiety. In vitro/vivo, both protein-bound and LMW DNICs are possibly identified and characterized by their distinctive electron paramagnetic resonance (EPR) signals at $g = 2.03$.⁴ Roussin's red esters (RREs), the dimeric form of DNICs, are interconvertible to DNICs and considered to perform the same role as DNICs.⁵ On the basis of oxidation levels of the $\{\text{Fe}(\text{NO})_2\}$ core of DNICs, DNICs can be divided into three major types; monomeric EPR-active $\{\text{Fe}(\text{NO})_2\}^9$, EPR-silent $\{\text{Fe}(\text{NO})_2\}^{10}$ and dimeric EPR-silent/-active $[\{\text{Fe}(\text{NO})_2\}^9-\{\text{Fe}(\text{NO})_2\}^9]/[\{\text{Fe}(\text{NO})_2\}^9-\{\text{Fe}(\text{NO})_2\}^{10}]$ DNICs.⁶ Ford and Li et al. have reported the X-ray structures of $\{\text{Fe}(\text{NO})_2\}^{10}$ $[\text{Fe}(\text{NO})_2(\text{imidazolate})]_4$ and $[\text{Fe}(\text{NO})_2(1\text{-MeIm})_2]$ DNICs with the [N,N] ligation mode.⁷ In addition to the varieties of $\{\text{Fe}(\text{NO})_2\}^9$ DNICs containing various ligation modes [S,S]/[S,O]/[S,N]/[N,N],⁸ Liaw *et. al.* demonstrated the interconversion among $[(\text{RS})_2\text{Fe}(\text{NO})_2]^-$, dimeric DNICs $[\text{Fe}(\mu\text{-SR})(\text{NO})_2]_2$ and anionic dimeric DNICs $[\text{Fe}(\mu\text{-SR})(\text{NO})_2]_2^-$ (R = ^tBu).⁹ Also, Liaw *et. al.* elucidated the anionic mixed thiolate-sulfide-bridged Roussin's red ester as a key intermediate in the transformation of DNICs/anionic RREs into $[2\text{Fe}-2\text{S}]$ clusters facilitated by HSCPh_3 via the reassembling process.¹⁰ Recently, we have reported the synthesis

of the neutral five-coordinate $\{\text{Fe}(\text{NO})_2\}^9$ DNICs $[(\text{TMEDA})\text{Fe}(\text{NO})_2\text{I}]$.¹¹ In this contribution, the anionic dimeric DNIC $[\text{Fe}(\mu\text{-SC}_6\text{H}_4\text{-}o\text{-N}(\text{CH}_3)_2)(\text{NO})_2]_2^-$ (**2**) and the reduction product $\{\text{Fe}(\text{NO})_2\}^{10} [(\text{SC}_6\text{H}_4\text{-}o\text{-N}(\text{CH}_3)_2)\text{Fe}(\text{NO})_2]^-$ (**3**) were isolated. Further, the reaction of complex **3** with $\text{Fe}(\text{TMEDA})(\text{NO})_2$ under carbon monoxide atmosphere yielded the first anionic, dimeric $\{\text{Fe}(\text{NO})_2\}^{10}\text{-}\{\text{Fe}(\text{NO})_2\}^{10} [\text{Fe}(\text{NO})_2(\mu\text{-SC}_6\text{H}_4\text{-}o\text{-N}(\text{CH}_3)_2)(\mu\text{-CO})\text{Fe}(\text{NO})_2]^-$ (**4**) DNIC containing the mixed thiolate–CO-bridged ligands.

2. Experimental Section

General Procedures. Manipulations, reactions, and transfers were conducted under nitrogen according to Schlenk techniques or in a glovebox (nitrogen gas). Solvents were distilled under nitrogen from appropriate drying agents (methylene chloride from CaH_2 ; acetonitrile from $\text{CaH}_2\text{-P}_2\text{O}_5$; diethyl ether, hexane and tetrahydrofuran(THF) from sodium benzophenone) and stored in dried, N_2 -filled flasks over 4Å molecular sieves. Nitrogen was purged through these solvents before use. Solvent was transferred to the reaction vessel via stainless cannula under positive pressure of N_2 . The reagents tetraphenylphosphonium bromide ($[\text{PPh}_4][\text{Br}]$), iron pentacarbonyl (Strem), 18-crown-6-ether, potassium triethylborohydride solution (1.0 M in tetrahydrofuran) (Aldrich-Sigma), and nitrosonium tetrafluoroborate (Alfa Aesar) were used as received. $[\text{PPN}][\text{Fe}(\text{CO})_3(\text{NO})]$,¹ $\text{Fe}(\text{TMEDA})(\text{NO})_2$ ² and bis[2-(*N,N*-dimethylamino)phenyl] disulfide³ have been prepared according to the literature procedure.

Physical Measurements. Infrared spectra of the carbonyl $\nu(\text{CO})$ and nitrosyl $\nu(\text{NO})$ stretching frequencies were recorded on a Jasco FT/IR-4100 spectrophotometer with sealed solution cells (0.1 mm) and KBr windows. UV/vis spectra were recorded on a GBC Cintra 101. ^1H NMR spectra were recorded in a

Varian Unity-400 spectrometer in CDCl₃ at room temperature. NMR spectra are referred to the internal residual solvent. Analyses of carbon, hydrogen, and nitrogen were obtained with a CHN analyzer (Heraeus). Crystallographic data and structure refinements parameters of complexes **2a**, **3** and **4b** are summarized in the Supplementary Material (Tables S1, S2 and S3). The crystals of **2a**, **3** and **4b** chosen for X-ray diffraction studies are measured in size 0.22 x 0.11 x 0.04 mm, 0.28 × 0.18 × 0.14 mm, and 0.40 × 0.32 × 0.25 mm, respectively. Each crystal was mounted on a glass fiber and quickly coated in epoxy resin. Unit-cell parameters were obtained by least-squares refinement. Diffraction measurements for complexes **2a**, **3** and **4b** were carried out on a Nonius Kappa CCD and Bruker SMART Apex CCD diffractometer using graphite-monochromated Mo K_α radiation ($\lambda = 0.7107 \text{ \AA}$) and between 2.07 and 25.32° for complex **2a**, 2.037 and 25.35° for complex **3**, between 2.33 and 26.36° for complex **4b**. Least-squares refinement of the positional and anisotropic thermal parameters for the contribution of all non-hydrogen atoms and fixed hydrogen atoms was based on F^2 . A SADABS absorption correction was made. The SHELXTL structure refinement program was employed.

Preparation of [Fe(μ -SC₆H₄-*o*-NMe₂)(NO)₂]₂ (1). To a Schlenk tube containing bis[2-(*N,N*-dimethylamino)phenyl] disulfide (0.608 g, 1 mmol) was added the THF solution (30 mL) of Fe(CO)₂(NO)₂ (2.5 mmol) freshly prepared (obtained from reaction of [NO][BF₄] (0.3 g, 2.5 mmol) and [PPN][Fe(CO)₃(NO)] (1.77 g, 2.5 mmol) in THF) by cannula under a positive pressure of N₂ at ambient temperature. The reaction mixture was stirred for 48 h and then dried under vacuum to afford the dark brown solid. 20 mL hexane and 10 mL diethyl diether the solution were added to dissolve the dark brown solid and then the reaction mixture was filtered through Celite. The filtrate was dried under vacuum to afford the dark brown solid [Fe(μ -SC₆H₄-*o*-NMe₂)(NO)₂]₂ (**1**) (yield: 0.456 g, 84.9%). IR ν_{NO} : 1808 w,

1778 s, 1752 s cm^{-1} (THF); 1809 w, 1781 s, 1754 s cm^{-1} (diethyl ether); 1809 w, 1781 s, 1756 s cm^{-1} (hexane). ^1H NMR (CDCl_3): δ 7.22 (d, 1H, ArH), 7.09 (t, 1H, ArH), 6.80 (t, 1H, ArH), 6.67 (d, 1H, ArH), 2.99 (br, 6H, NCH_3). Absorption spectrum (THF) [λ_{max} , nm (ϵ , $\text{M}^{-1} \text{cm}^{-1}$): 314 (30634), 370 (24095), 586 (3278), 806 (343).

Preparation of [cation][Fe(μ -SC₆H₄-*o*-NMe₂)(NO)₂]₂ (2) (cation = K-18-crown-6-ether (2a), [PPh₄] (2b)). To a stirred solution of complex **1** (0.642 g, 1.2 mmol) in THF (10 mL) was added 1 mL of KBHET₃ THF solution (1 M) dropwise under N₂ at 0 °C. After being stirred for 10 min, the green reaction solution was transferred to the 20 mL Schlenk flask loaded with 18-crown-6-ether (0.265 g, 1 mmol)(or [PPh₄][Br] (0.42 g, 1 mmol)). When the reaction solution was stirred for 3 h, the reaction solution was filtered through Celite and hexane was added to yellow-green filtrate to precipitate the yellow-green solid [K-18-crown-6-ether][Fe(μ -SC₆H₄-*o*-NMe₂)(NO)₂]₂ (**2a**) (yield: 0.552 g, 65.7%; **2b**: 0.73 g, 83.3%). IR ν_{NO} : 1684 s, 1664 s cm^{-1} (THF). Absorption spectrum (THF) [λ_{max} , nm (ϵ , $\text{M}^{-1} \text{cm}^{-1}$): 309 (29992), 371 (12248), 509 (870).

Preparation of [K-18-crown-6-ether][Fe(SC₆H₄-*o*-NMe₂)(NO)₂] (3). 0.3 mL THF solution (1 M) of KBHET₃ was added dropwise to the THF solution (10 mL) containing complex **2a** (0.252 g, 0.3 mmol) and 18-crown-6-ether (0.079 g, 0.3 mmol) at 0 °C under N₂ atmosphere. After the reaction solution was stirred for 10 min, the reaction mixture was filtered through Celite to afford the light brown filtrate. The volume of the filtrate was reduced to 3 mL under vacuum and then hexane (25 mL) was added to precipitate the light brown solid [K-18-crown-6-ether][Fe(SC₆H₄-*o*-NMe₂)(NO)₂] (**3**) (yield: 0.224 g, 65.2%). Hexane was added slowly to the layer above the THF solution of complex **3** and the Schlenk tube was tightly sealed. After the Schlenk tube stored in the refrigerator at

-15°C for 7 days, the dark brown crystals suitable for X-ray diffraction analysis were isolated. IR ν_{NO} : 1660 s, 1610 s cm^{-1} (THF). Absorption spectrum (THF) [λ_{max} , nm (ϵ , $\text{M}^{-1} \text{cm}^{-1}$): 319 (20036), 371 (10642), 524 (2637), 780 (650). ^1H NMR (CDCl_3): δ 7.22 (d, 1H, ArH), 7.09 (t, 1H, ArH), 6.80 (t, 1H, ArH), 6.67 (d, 1H, ArH), 2.99 (br, 6H, NCH_3).

Preparation of $[\text{PPh}_4][\text{Fe}_2(\mu\text{-SC}_6\text{H}_4\text{-}o\text{-NMe}_2)(\mu\text{-CO})(\text{NO})_4]$ (4b**).** THF solution of 0.4 mmol $\text{Fe}(\text{CO})_2(\text{NO})_2$, prepared freshly from reaction of $[\text{NO}][\text{BF}_4]$ and $[\text{PPN}][\text{Fe}(\text{CO})_3(\text{NO})]$ in 1:1 ratio, was transferred to a 50 mL Schlenk flask containing complex **2b** (0.35 g, 0.4 mmol) by cannula under a positive pressure of N_2 at ambient temperature. The reaction solution was stirred for 3 hr and then the reaction mixture was filtered to afford the blue filtrate. After the blue filtrate was dried under vacuum, 30 mL diethyl diether was added to separate product $[\text{PPh}_4][\text{Fe}_2(\mu\text{-SC}_6\text{H}_4\text{-}o\text{-NMe}_2)(\mu\text{-CO})(\text{NO})_4]$ (**4b**) (diethyl diether insoluble) and complex **1** (diethyl ether soluble). After drying under vacuum, the yield of complex **1** was 0.079 g (73.8 %) and the yield of complex **4b** was 0.222 g (74%). The blue THF solution of complex **4b** was layered with hexane at -15°C for 10 days to afford dark blue crystals suitable for X-ray crystallography. IR: 1843 $w(\nu_{\text{CO}})$, 1705 s, 1691 s (ν_{NO}) cm^{-1} (THF). ^1H NMR (CDCl_3): δ 7.82 (br m, 4H, ArH), 2.99 (br, 6H, NCH_3). Absorption spectrum (THF) [λ_{max} , nm (ϵ , $\text{M}^{-1} \text{cm}^{-1}$): 314 (20696), 381 (14646), 606 (3095), 975 (839).

Reaction of complex 2a with $\text{Fe}(\text{TMEDA})(\text{NO})_2$ and CO. A solution containing 0.114 g (0.2 mmol) of complex **2a** and 0.046 g (0.2 mmol) of $\text{Fe}(\text{TMEDA})(\text{NO})_2$ in THF (5 mL) was stirred under CO atmosphere for 1 h at room temperature. The IR spectrum (THF): 1843 $w(\nu_{\text{CO}})$, 1705 s, 1691 s (ν_{NO}) cm^{-1} was identical to that of complex **4b**. The blue solution was then filtered through Celite and hexane (25 mL) added to precipitate the air-sensitive dark blue solid

[K-18-crown-6-ether][Fe₂(μ-SC₆H₄-*o*-NMe₂)(μ-CO)(NO)₄] (**4a**) (yield: 0.11 g, 78%).

3. Results and Discussion

The THF solution of complex **1** and KHBET₃ was stirred at 0°C for 10 min (Scheme 1a); a reduction occurred to yield complex **2**. IR spectrum of complex **2** in [K-18-crown-6-ether]⁺ salt exhibits diagnostic ν_{NO} stretching frequencies at 1684 s, 1664 s cm⁻¹ (THF) with Δν_{NO} = 20 cm⁻¹. The IR spectra for complexes **1** and **2** have the different pattern/position (1808 vw, 1778 s, 1752 s cm⁻¹ for **1** vs 1684 s, 1664 s cm⁻¹ (THF) for **2**) and Δν_{NO} (Δν_{NO} = 26 cm⁻¹ for **1** vs Δν_{NO} = 20 cm⁻¹ for **2**).¹² In contrast to complex **1** exhibiting four absorption bands at 314, 370, 586, 806 nm (THF) and complex [Fe(μ-SEt)₂](NO)₂]₂⁻,¹³ complex **2** displays three absorption bands at 309, 371, 509 nm (THF). The EPR spectrum of complex **2** displays an isotropic signal at g = 2.002 at 298 K (Supporting information S1). Reaction of complex **2** and KHBET₃ led to the formation of complex **3** in THF solution at 0°C (Scheme 1b). Complex **3** displays EPR-silent {Fe(NO)₂}¹⁰ electronic structure with N/S ligation mode. The IR spectrum of complex **3** also exhibits diagnostic ν_{NO} stretching frequencies at 1660 s, 1610 s cm⁻¹ (THF) with Δν_{NO} = 50 cm⁻¹. The single-crystal X-ray structures of complex **2b** and **3** are depicted in Figure 1.

Upon addition of 1 equiv of Fe(TMEDA)(NO)₂ into complex **3** under CO atmosphere in THF (Scheme 1c), a pronounced color change from brown to dark blue occurs at ambient temperature. The formation of EPR-silent complex **4** was confirmed by IR, UV-vis, and single-crystal X-ray diffraction. The electronic structure of complex **4** is best described as the anionic dinuclear {Fe(NO)₂}¹⁰-{Fe(NO)₂}¹⁰ DNIC. Obviously, the strong π-accepting bridging-CO plays a key role to stabilize the {Fe(NO)₂}¹⁰-{Fe(NO)₂}¹⁰ complex **4** via relieving

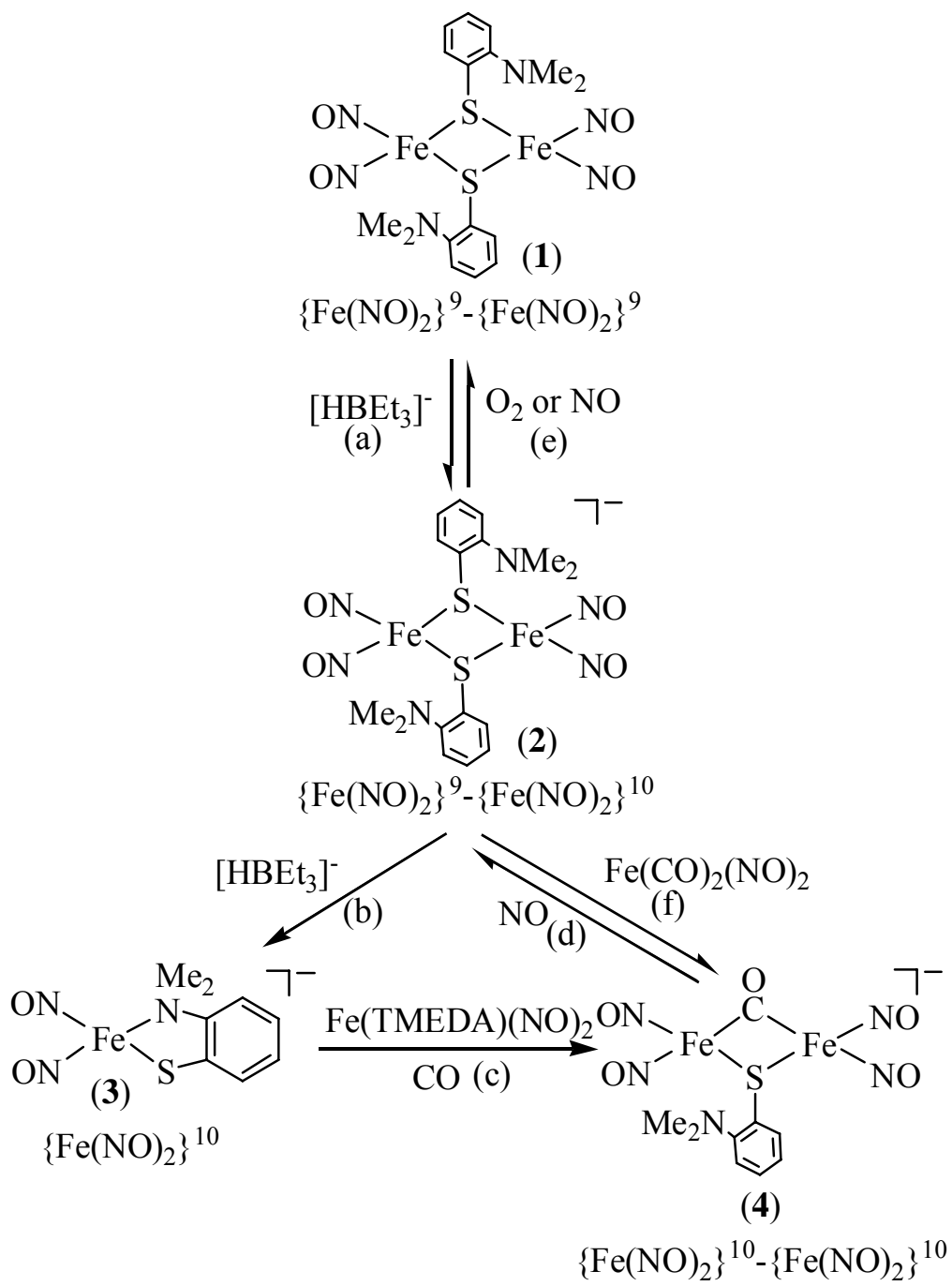
the electronic richness of $[\{\text{Fe}(\text{NO})_2\}^9-\{\text{Fe}(\text{NO})_2\}^{10}]$ centers. As presented in Scheme 1f, upon the addition of $\text{Fe}(\text{CO})_2(\text{NO})_2$ into the THF solution of complex **2** in a 1:1 stoichiometry, a reaction ensued over the course of 3 h to yield the anionic complex **4** along with complex **1** in the yields of 1:2 molar ratio. Presumably, $\text{Fe}(\text{CO})_2(\text{NO})_2$ acts as $\{\text{Fe}(\text{NO})_2\}^{10}$ - as well as CO-donor reagent in this reaction. One of the labile CO derived from $\text{Fe}(\text{CO})_2(\text{NO})_2$ bound to the Fe of $\{\text{Fe}(\text{NO})_2\}^{10}$ part of complex **2** accompanied by the bridged-thiolate cleavage may rationalize the formation of complex **1** derived from dimerization of $[\text{Fe}(\text{NO})_2(\text{SC}_6\text{H}_4\text{-}o\text{-N}(\text{CH}_3)_2)]$ motifs. The subsequent combination of $[\text{Fe}(\text{NO})_2(\text{SC}_6\text{H}_4\text{-}o\text{-N}(\text{CH}_3)_2)(\text{CO})]$ and $[\text{Fe}(\text{NO})_2]$ motif led to the formation of complex **4**. The IR spectrum of complex **4b** shows ν_{NO} stretching frequencies at 1705 s, 1691s cm^{-1} and ν_{CO} stretching frequency at 1843 w cm^{-1} (THF). The absorbance bands of complex **4b** are at 314, 381, 606, 975 nm.

The single-crystal X-ray structure of $[\text{Fe}(\text{NO})_2(\mu\text{-SC}_6\text{H}_4\text{-}o\text{-N}(\text{CH}_3)_2)(\mu\text{-CO})\text{Fe}(\text{NO})_2]^-$ unit in PPh_4 salt (**4b**) is depicted in Figure 2. Two nitrosyl groups and bridging thiolate and carbonyl define the distorted tetrahedral geometry of each iron atom leading to an acute angle $\text{Fe}(1)\text{-S}(1)\text{-Fe}(2)$ $82.31(10)^\circ$ and $\text{S}(1)\text{-Fe}(1)\text{-C}(1)$ $103.86(8)^\circ$. The $[\text{Fe}(\mu\text{-S})(\mu\text{-C})\text{Fe}]$ core geometry of complex **4b** is best described as a butterfly-like structure with the dihedral angle of 170.95° (the intersection of the Fe_2S and Fe_2C planes). As observed in this study, reduction of $[\{\text{Fe}(\text{NO})_2\}^9-\{\text{Fe}(\text{NO})_2\}^9]$ complex **1** to $[\{\text{Fe}(\text{NO})_2\}^9-\{\text{Fe}(\text{NO})_2\}^{10}]$ complex **2** results in the elongation of Fe-S and $\text{Fe}(1)\cdots\text{Fe}(1A)$ bond distances to relieve the richness of electron density surrounding $[\{\text{Fe}(\text{NO})_2\}^9-\{\text{Fe}(\text{NO})_2\}^{10}]$ $[\text{Fe}(\mu\text{-S})_2\text{Fe}]$ centers.^{8c} In contrast, the shorter $\text{Fe}\cdots\text{Fe}$ distance (2.5907 (5) Å) found in the electron-rich complex **4b** may be ascribed to the shorter bridging Fe-S (2.2805(7) Å and 2.2737(7) Å) and Fe-C (1.960(3) Å and

1.976 (3) Å) bond distances. The mean N–O bond length of 1.180 (3) Å in complex **4b**, slightly shorter than the average N–O bond distance of 1.187 (6) Å observed in complex **2b**, is nearly at the lower end of 1.214 (6)–1.189 (4) Å for the neutral $\{\text{Fe}(\text{NO})_2\}^{10}$ DNICs.^{8c} Meanwhile, the mean Fe–N(O) distances of 1.659 (2) Å in complex **4b** also approach the upper end of 1.650 (7) –1.638 (3) Å for the neutral neutral $\{\text{Fe}(\text{NO})_2\}^{10}$ DNICs.^{8c} The Fe–C bond distances (1.960(3) Å and 1.976(3) Å) of complex **4** are slightly longer than those found in $[(\mu\text{-SR})(\mu\text{-CO})\text{Fe}_2(\text{CO})_6]^{-1}$ (R = C₆H₂Me₃) (1.927(7) Å and 1.925 Å) and the C=O bond distance of 1.156 (3) Å for the bridged carbonyl of **4b** is shorter than $[(\mu\text{-SR})(\mu\text{-CO})\text{Fe}_2(\text{CO})_6]^{-1}$ (R = C₆H₂Me₃) (1.208(7) Å).¹⁴ The reformation of complex **2** upon addition of NO gas into complex **4b** demonstrated that the CO-bridging ligand of complex **4b** is labile (Scheme 1d).

Here, we demonstrate the interconversion of $[\{\text{Fe}(\text{NO})_2\}^9\text{-}\{\text{Fe}(\text{NO})_2\}^9]$, $[\{\text{Fe}(\text{NO})_2\}^9\text{-}\{\text{Fe}(\text{NO})_2\}^{10}]$, $[\{\text{Fe}(\text{NO})_2\}^{10}\text{-}\{\text{Fe}(\text{NO})_2\}^{10}]$ and $[\{\text{Fe}(\text{NO})_2\}^{10}]$ DNICs. The first anionic dinuclear $[\{\text{Fe}(\text{NO})_2\}^{10}\text{-}\{\text{Fe}(\text{NO})_2\}^{10}]$ complex **4** provides an evidence that CO can serve as a bridging ligand to stabilize the dimeric $[\{\text{Fe}(\text{NO})_2\}^{10}\text{-}\{\text{Fe}(\text{NO})_2\}^{10}]$ DNICs. It may imply in addition to the permissive role of endothelial NO in CO-induced cerebrovascular dilation¹⁵, CO may contribute itself as a labile ligand to stabilize the dimeric DNICs for the demand in biological system.

Scheme 1.



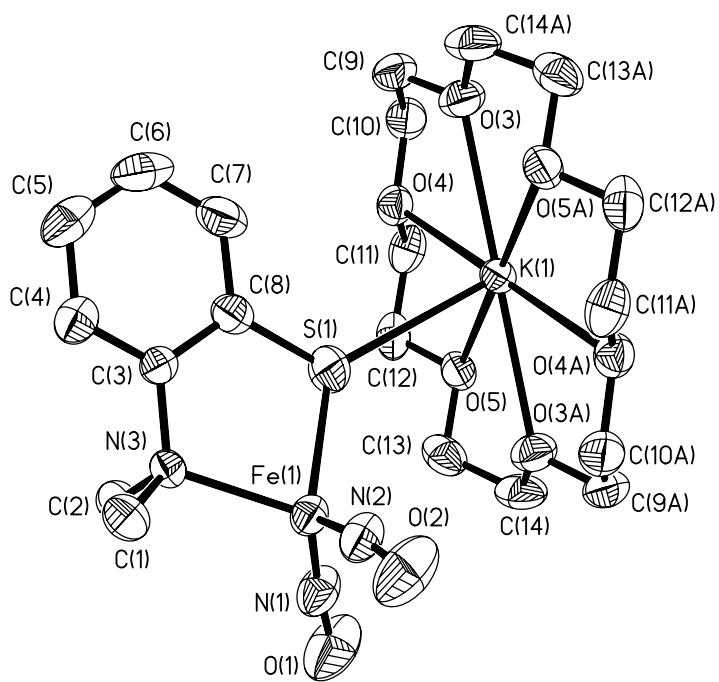
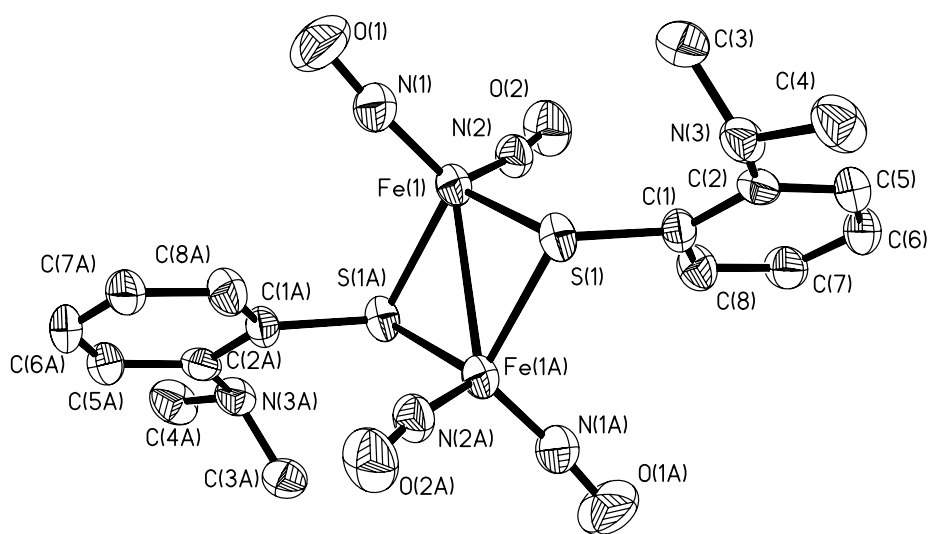


Figure 1. X-ray diffraction structures of complexes **2b** and **3**.

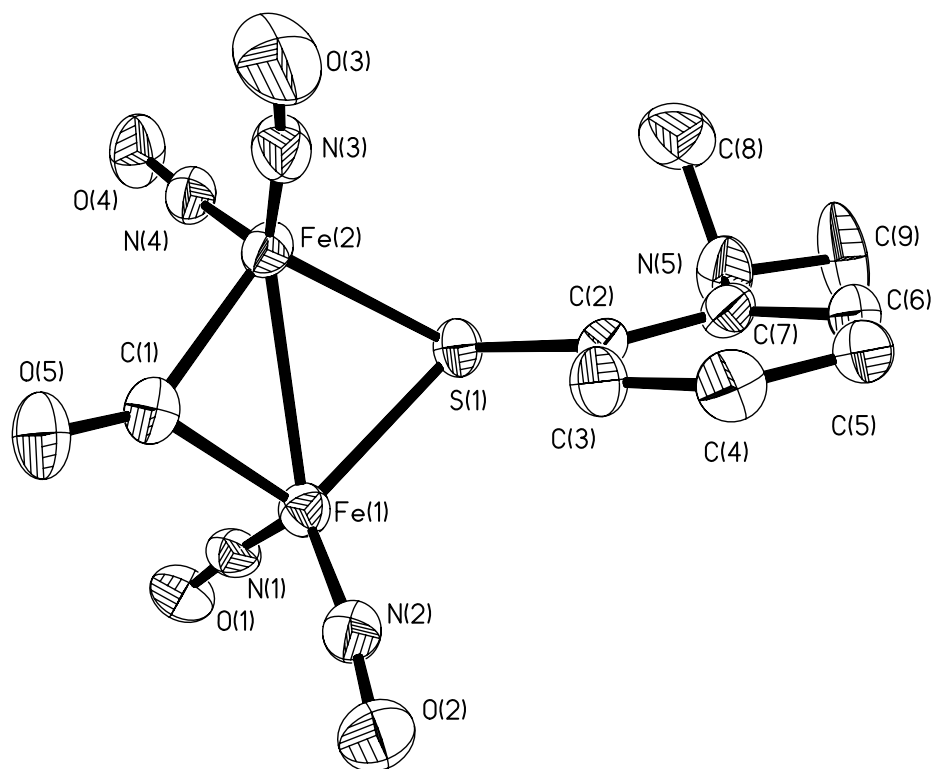


Figure 2. ORTEP drawing and labeling scheme of $[\text{Fe}(\text{NO})_2(\mu\text{-SC}_6\text{H}_4\text{-}o\text{-N}(\text{CH}_3)_2)(\mu\text{-CO})\text{Fe}(\text{NO})_2]^-$ unit in PPh_4 salt (**4b**) with thermal ellipsoids draw at 50% probability. Selected bond distances (Å) and angles (deg): Fe(1)···Fe(2) 2.5907(5); Fe(1)–N(1) 1.664(2); Fe(1)–N(2) 1.658(2); Fe(2)–N(3) 1.653(2); Fe(2)–N(4) 1.660(2); Fe(1)–S(1) 2.2805(7); Fe(2)–S(1) 2.2737(7); Fe(1)–C(1) 1.960(3); Fe(2)–C(1) 1.976(3); O(1)–N(1) 1.186(3); O(2)–N(2) 1.177(3); O(3)–N(3) 1.177(3); O(4)–N(4) 1.180(3); C(1)–O(5) 1.156(3); N(1)–Fe(1)–N(2) 120.65(11); N(1)–Fe(1)–S(1) 109.17(7); N(2)–Fe(1)–S(1) 115.87(8); N(1)–Fe(1)–C(1) 103.07(10); N(2)–Fe(1)–C(1) 101.51(11); S(1)–Fe(1)–C(1) 103.86(8); O(1)–N(1)–Fe(1) 172.1(2); O(2)–N(2)–Fe(1) 172.2(2).

4. Conclusions

$[\text{Fe}(\mu\text{-SC}_6\text{H}_4\text{-}o\text{-NMe}_2)(\text{NO})_2]_2$ (**1**), $[\text{Fe}(\mu\text{-SC}_6\text{H}_4\text{-}o\text{-NMe}_2)(\text{NO})_2]_2^-$ (**2**), $[\text{Fe}(\text{SC}_6\text{H}_4\text{-}o\text{-NMe}_2)(\text{NO})_2]^-$ (**3**), and $[\text{Fe}_2(\mu\text{-SC}_6\text{H}_4\text{-}o\text{-NMe}_2)(\mu\text{-CO})(\text{NO})_4]^-$ (**4**) have been synthesized successfully and characterized by IR, UV/vis, ^1H NMR, and SQUID. Studies on these dinitrosyl iron complexes may allow more understanding of geometrical structures, electronic properties, and reactivity patterns of nitrosyl complexes

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無研發成果推廣資料

97 年度專題研究計畫研究成果彙整表

計畫主持人：陳建宏		計畫編號：97-2113-M-040-002-MY2					
計畫名稱：含鐵、錳硝基化合物之合成及反應性探討及其做為一氧化氮供給劑與催化一氧化氮轉換之研究							
成果項目			量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）
			實際已達成數（被接受或已發表）	預期總達成數（含實際已達成數）	本計畫實際貢獻百分比		
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
國外	論文著作	期刊論文	2	2	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%	章/本	
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		

<p>其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)</p>	無
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科 教 處 計 畫 加 填 項 目	成果項目	量化	名稱或內容性質簡述
	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與(閱聽)人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

達成目標

未達成目標（請說明，以 100 字為限）

實驗失敗

因故實驗中斷

其他原因

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文： 已發表 未發表之文稿 撰寫中 無

專利： 已獲得 申請中 無

技轉： 已技轉 洽談中 無

其他：（以 100 字為限）

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）（以 500 字為限）

我們成功的合成一些鐵硝基化合物期望藉以釋放一氧化氮。目前正繼續再對這些化合物作各種物理及化學性質的探討，希望對一氧化氮從金屬化合物釋放出來，或被金屬化合物吸收有更多的瞭解，並藉以設計出更有效率的一氧化氮給予劑。另外我們也希望對這些已合成的鐵化合物的反應探討能對以金屬來催化一氧化氮轉變有更多的瞭解。