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TRANSLATION

METHOD OF OBTAINING A HEAT-RESISTANT PARAMAGNETIC POLYMER

By

V. P. Parini and A. A. Berlin

FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

WRIGHT-PATTERSON AIR FORCE BASE

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UNEDITED ROUGH DRAFT TRANSLATION

METHOD OF OBTAINING A HEAT-RESISTANT PARAMAGNETIC POLYMER

BY: V. P. Parini and A. A. Berlin

English Pages: 2

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METHOD OF OBTAINING A HEAT-RESISTANT PARAMAGNETIC POLYMER

V. P. Parini and A. A. Berlin

The familiar method for obtaining a heat-resistant paramagnetic polymer is the reaction of diamine with -p-benzoquinone or its halogen substitute which contains labile hydrogen or halogen atoms adjacent to the carboxylic oxygen.

The proposed method, compared to the familiar method, broadens the source of raw materials for obtaining a heat-resistant paramagnetic polymer. The distinguishing feature of this method is that aromatic diamine is subjected to reaction with quinone, free of labile hydrogen atoms adjacent to the keto group. The polymers thus obtained have increased heat resistance; their specific electrical conductance at 25° is 10^{-9} to 10^{-7} ohm^{-1} cm^{-1}, with conductance energy of 0.25 to 0.3 ev.

Example 1. A mixture of 2.7 g (0.05 meta position) of phenylene-diamine and 5.2 g (0.05 meta position) of anthraquinone is heated at 300° for 3 hours in a sealed ampoule in an inert atmosphere. The solid product of the reaction is crushed, washed by boiling alcohol,

dried, freed from the low-molecular-weight impurities, and kept at a temperature of 200° and a pressure of 10^{-3} mm for 2 hours. The obtained product is black powder which is insoluble in alcohol, acetone, dioxane, and xylene, and which is partly soluble in pyridine, dimethylformamide, and 98% sulfuric acid. The product yield is 5.9 g. At elevated temperatures the obtained paramagnetic polymer undergoes a weight loss: at 400° – 2%, at 500° – 4%, at 600° – 7.5%.

Example 2. A mixture of 2.3 g (0.025 meta position) of benzidine and 2.6 g (0.025 meta position) of anthraquinone is subjected to a reaction as in Example 1. We obtain 3.3 g of a black powder which is insoluble in alcohol, partly soluble in acetone and dioxane, almost completely soluble in pyridine, dimethylformamide, and sulfuric acid, and soluble in 98% sulfuric acid (the solutions have a green color).

Rigid films can be obtained on evaporation of the organic solvents from the solutions. The obtained paramagnetic polymer undergoes the following weight losses with elevated temperatures: at 300° – 2%, at 400° – 5%, and 500° – 8%.

Object of the Invention

The method of obtaining a heat-resistant paramagnetic polymer by the reaction of diamine with quinone has the distinguishing feature that in order to expand the raw materials, aromatic diamine is subjected to a reaction with quinone, free of labile hydrogen atoms adjacent to the keto group.

ORGANIC CHEMISTRY
ASTIA

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1ST ANALYST [illegible] DATE 4/23

2ND ANALYST [illegible] DATE 4/23

ALKYL

210.1	01	0	ALKANES
3015.25		1	1C
1663.25		2	2C
3885.25		3	3C
0745.25		4	4C
3561.25		5	5C
2288.25		6	6C
2285.25		7	7C
3392.25		8	8C
3311.25		9	9C
1245.5		11	10C
0210.11	01	12	10+C
0210.14	02	0	TERMINAL
0210.12		1	NONTERMINAL
0210.13		2	POLY USAGE

ALKENES

0210.15		3	ALKENES
3015.5		4	=CH2
1663.75		5	C=C
3885.75		6	3C
0745.75		7	4C
3561.75		8	5C
2288.75		9	6C
2285.75		11	7C
3392.75	02	12	8C
3311.75	03	0	9C
1247.5		1	10C
0210.16		2	10+C
0210.20		3	TERMINAL
0210.17		4	NONTERMINAL
0210.18		5	POLY =
0210.19		6	POLY USAGE

ALKYNYL

0211.2		7	ALKYNES
3015.75		8	≡C
0022.5		9	C≡C
3906.5		11	3C
0747.5	03	12	4C
3565.5	04	0	5C
0211.3		1	6+C
0211.7		2	TERMINAL
0211.4		3	NONTERMINAL
0211.5		4	POLY ≡
0211.6		5	POLY USAGE

ARYL

0570.10		6	BENZENE
0570.15		7	MONOSUB
0570.11		8	DISUB
0570.21		9	TRISUB
0570.16		11	ORTHO
0570.14	04	12	META
0570.17	05	0	PARA
0570.20		1	SYM-TRISUB
0570.19		2	POLYSUB
0570.13		3	IND
0570.12		4	FUSED
0570.18		5	POLY USAGE

CYCLOALKANES

1225.10		6	CYCLOALKANES
1225.11		7	3,4M
1225.12		8	5M
1225.13		9	6M
1225.14		11	7+M
1225.19	05	12	SAT
1225.21	06	0	UNSAT
1225.15		1	BICYCLO
1225.17		2	IND
1225.16		3	FUSED
1225.20		4	SPIRO
1225.18		5	POLY USAGE

HALOGENS

2214		6	HALOGENS
1883.2		7	F
0921.5		8	Cl
0724.5		9	Br
2586.5		11	I
0421	06	12	At
2214.5	07	0	POLY USAGE

CARBONYL

0803.7		1	CARBONYL
0803.2		2	C=O
1915.5		3	HC=O
5091.6		4	C=S
5091.30		5	HC=S
3468.25		6	O=(RING)
5090.11		7	S= (RING)
2982.5		8	MET.CARBONYLS
3461.5		9	-C(=O)-C(=O)-
0803.5		11	POLY USAGE
0803.4	07	12	MISC.

COOR

0804.3	08	0	COOR
0804.1		1	-COO-ESTER
0804.2		2	COOH
0804.7		3	CARBOXY HALIDES
0804.6		4	F-C=O
0804.5		5	Cl-C=O
0804.4		6	Br-C=O
0804.8		7	I-C=O
0804.9		8	OCOO
0182.5		9	-C(=O)-O-C(=O)-
0805.25		11	METAL SALT
0805.75	08	12	POLY USAGE
0805.5	09	0	MISC.

S-COOR

5090.15		1	S-COOR
5090.12		2	THIO ACIDS (CXXH)
5091.5		3	S=C-O
5091.4		4	O=C-S
5090.22		5	-S-COOH
5090.20		6	S=C-HALOGEN
5090.17		7	S=C-Br
5090.15		8	S=C-Cl
5090.19		9	S=C-F
5090.21		11	S=C-I
5090.14	09	12	POLY USAGE
5090.13	10	0	MISC.

S - HETERO

4863.10		1	S-HETERO
4863.14		2	3, 4M
4863.15		3	5M
4863.16		4	6M
4863.17		5	7+M
4863.21		6	O-CONT.
4863.20		7	N-CONT.
4863.22		8	OTHER-CONT.
4863.11		9	IS
4863.12		11	2S
4863.12	10	12	3+S
4863.19	11	0	IND
4863.18		1	FUSED
4863.24		2	SPIRO
4863.23		3	POLY USAGE

N - HETERO

3298.10		4	N-HETERO
3298.14		5	3, 4M
3298.15		6	5M
3298.16		7	6M
3298.17		8	7+M
3298.20		9	O-CONT.
3298.23		11	S-CONT.
3298.21	11	12	OTHER-CONT.
3298.11	12	0	IN
3298.12		1	2N
3298.13		2	3+N
3298.24		3	SALT
3298.19		4	IND
3298.18		5	FUSED
3298.25		6	SPIRO
3298.22		7	POLY USAGE

O-HETERO

3475.10		8	O-HETERO
3475.13		9	3, 4M
3475.14		11	5M
3475.15	12	12	6M
3475.16	13	0	7+M
3475.19		1	N-CONT.
3475.22		2	S-CONT.
3475.20		3	OTHER-CONT.
3475.11		4	I-O
3475.12		5	2+O
3475.18		6	IND
3475.17		7	FUSED
3475.23		8	SPIRO
3475.21		9	POLY USAGE

N, C, S

3297.5		11	N,C,S
5090.16	13	12	=N-C=S
1398.75	14	0	-N-C(=S)-S
5091.7		1	=N-C(=S)-N=
5091.20		2	-S-CN
2618.5		3	-N=C=S
3297.7		4	POLY USAGE
3297.6		5	MISC.

N, C, O

3297.2		6	N,C,O
4462.5		7	NC(=O)-N-N-
0785.25		8	-N-C(=O)-O-
5361.5		9	=N-C(=O)-N=
0785.75		11	-C(=O)-N-
2613.25	14	12	-N=C=O
1222.5	15	0	-O-CN
3297.4		1	POLY USAGE
3297.3		2	MISC.

C, N

0797.25		3	C,N
1223.5		4	CN
2613.75		5	-N=C
0239.2		6	-N-C≡N
2150.5		7	-N-C(=N)-N-
0787.5		8	-N=C=N-
0797.75		9	POLY USAGE
0797.5		11	MISC.

OH, SH

2391.6	15	12	OH, SH
2391.4	16	0	OH
2968.25		1	SH
2391.8		2	POLY USAGE

N, O, (S)

3298.27		3	N,O (S)
2391.2		4	= N-OH
2968.75		5	= N-SH
3295.5		6	NO2
3299.75		7	-N=O
3299.25		8	-N-N=C
3289.5		9	N-NO2
3298.29		11	POLY USAGE
3298.27	16	12	MISC.

S, O, (N)

4863.25	17	0	S, O (N)
4860.75		1	O=S=O
4860.25		2	SO3H
4859.5		3	S=O
4860.5		4	SO2-N
4863.27		5	POLY USAGE
4863.26		6	MISC.

O, S

[redacted]			
3468.75			
3587.5			
5090.10			
1398.25	1		
5257.5	1		
3475.28			

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S – HETERO

4863.10		1	S–HETERO
4863.14		2	3, 4M
4863.15		3	5M
4863.16		4	6M
4863.17		5	7+M
4863.21		6	O–CONT.
4863.20		7	N–CONT.
4863.22		8	OTHER–CONT.
4863.11		9	1S
4863.12		11	2S
4863.12	10 12		3+S
4863.19	11 0		IND
4863.18		1	FUSED
4863.24		2	SPIRO
4863.23		3	POLY USAGE

N – HETERO

3298.10		4	N–HETERO
3298.14		5	3, 4M
3298.15		6	5M
3298.16		7	6M
3298.17		8	7+M
3298.20		9	O–CONT.
3298.23		11	S–CONT.
3298.21	11 12		OTHER–CONT.
3298.11	12 0		1N
3298.12		1	2N
3298.13		2	3+N
3298.24		3	SALT
3298.19		4	IND
3298.18		5	FUSED
3298.25		6	SPIRO
3298.22		7	POLY USAGE

O–HETERO

3475.10		8	O–HETERO
3475.13		9	3, 4M
3475.14		11	5M
3475.15	12 12		6M
3475.16	13 0		7+M
3475.19		1	N–CONT.
3475.22		2	S–CONT.
3475.20		3	OTHER–CONT.
3475.11		4	1–O
3475.12		5	2+O
3475.18		6	IND
3475.17		7	FUSED
3475.23		8	SPIRO
3475.21		9	POLY USAGE

N, C, S

3297.5		11	N,C,S
5090.16	13 12		=N–C=S
1398.75	14 0		–N–C(=S)–S
5091.7		1	=N–C(=S)–N=
5091.20		2	–S–CN
2618.5		3	–N=C=S
3297.7		4	POLY USAGE
3297.6		5	MISC.

N, C, O

3297.2		6	N,C,C
4462.5		7	NC(=O)–N–N–
0785.25		8	–N–C(=O)–O–
5361.5		9	=N–C(=O)–N=
0785.75		11	–C(=O)–N–
2613.25	14 12		–N=C=O
1222.5	15 0		–O–CN
3297.4		1	POLY USAGE
3297.3		2	MISC.

C, N

0797.25		3	C,N
1223.5		4	CN
2613.75		5	–N=C
0239.2		6	–N–C≡N
2150.5		7	–N–C(=N)–N–
0787.5		8	–N=C=N–
0797.75		9	POLY USAGE
0797.5		11	MISC.

OH, SH

2391.6	15 12		OH, SH
2391.4	16 0		OH
2968.25		1	SH
2391.8		2	POLY USAGE

N, O, (S)

3298.27		3	N,O (S)
2391.2		4	=N–OH
2968.75		5	=N–SH
3295.5		6	NO2
3299.75		7	–N=O
3299.25		8	–N–N=C
3289.5		9	N–NO2
3298.29		11	POLY USAGE
3298.27	16 12		MISC.

S, O, (N)

4863.25	17 0		S, O (N)
4860.75		1	O=S=O
4860.25		2	SO3H
4859.5		3	S=O
4860.5		4	SO2–N
4863.27		5	POLY USAGE
4863.26		6	MISC.

O, S

[redacted]		7	O,S
[redacted]		8	–O–
3587.5		9	–O–O–
5090.10		11	–S–
1398.25	17 12		–S–S–
5257.5	18 0		–S–S–S–
3475.28		1	POLY USAGE
[redacted]		2	MISC.

AMINES

0239.5		3	AMINES
3852.5		4	NH2– (PRI)
4442.5		5	–NH– (SEC)
5036.5		6	–N= (TER)
3984.5		7	–N≡ (QUAT)
2442.5		8	=N
0503.5		9	–N=N–
1329.5		11	N≡N (N≡N≡)
2359.5	18 12		–N–N–
5251.5	19 0		N–N=N–
0501.5		1	
1883.4		2	FLUOROAMINES
1883.8		3	–NF2
1883.6		4	–NF
1884.5		5	F2N–NF–
0239.4		6	SALT (NON–QUAT)
0239.9		7	POLY USAGE
0239.7		8	MISC.

PHOSPHORUS

3634.2		9	PHOSPHORUS RAD.
3634.16		11	P=O,S,O
3634.18	19 12		P=S,2O
3634.17	20 0		P=O, S, 2O
3634.19		1	S=PO3
3634.15		2	S=P–F
3634.14		3	S–P–F
3634.11		4	O=P(N) (O)–F
3634.10		5	O=P, (F), 2N
3634.13		6	O=P(F) O2
3634.12		7	O–P–F
3634.23		8	P,S–(1 TO 3S)
3634.24		9	P,S–(4S)
1224.75		11	CYCLIC P
3632.25	20 12		P(+3)
3632.75	21 0		P(+5)
3617.5		1	PO4
3634.21		2	P–MISC.
3634.25		3	P,S–MISC.
3634.22		4	POLY USAGE

BORANES

0687		5	BORANES

SILANES

4530		6	SILANES

MISCELLANEOUS

22	23
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
11	11
12	12

METALS AND METALLOIDS

2140	24 0		GROUP I
0205		1	ALKALI
0877		2	Cs
1925		3	Fr
2787		4	Li
3806		5	K
4592		6	Na
4365		7	Rb
1134		8	Cu
2102		9	Au
4542		11	Ag
2141	24 12		GROUP II
0208	25 0		ALKALINE
0536		1	Ba
0573		2	Be
0760		3	Ca
2845		4	Mg
4110		5	Ra
4821		6	Sr
0755		7	Co
0970		8	Hg
5585		9	Zn
2142		11	GROUP III
0043	25 12		Ac
0232	26 0		Al
1996		1	Ga
2467		2	In
2707		3	La
4410		4	Sc
5055		5	Tl
5583		6	Y
2143		7	GROUP IV
2072		8	Ge
2201		9	Hf
2719		11	Pb
5128	26 12		Sn
5139	27 0		Ti
5590		1	Zr
2144		2	GROUP V
0330		3	Sb
0610		4	Bi
3287		5	Nb
		6	P
4956		7	Ta
5381		8	V
2145		9	GROUP VI
0883		11	CHALCOGENS
3781	27 12		Po
4457	28 0		Se
0935		1	Cr
3122		2	Mo
5277		3	W
2146		4	GROUP VII
5223		5	TRANS. ELEM.
0992		6	Co
2604		7	Ir
2607		8	Fe
3276		9	Ni
3456		11	Os
3492	28 12		Pd
3744	29 0		Pt
4277		1	Rh
4373		2	Ru

2

FRAGMENT RELATIONSHIPS

ALKYL

30 0	ARYL
1	CYCLOALKYL
2	HALOGENS
3	CARBONYL
4	COOR
5	S–COOR
6	S–HETERO
7	N–HETERO
8	O–HETERO
9	N,C,S
11	N,C,O
30 12	C,N
31 0	N,O (S)
1	OH, SH
2	S,O (N)
3	O,S
4	AMINES
5	PHOSPHORUS
6	METALS
7	BORANES
8	SILANES
9	MISC.

ALKENYL

11	ARYL
31 12	CYCLOALKYL
32 0	HALOGENS
1	CARBONYL
2	COOR
3	S–COOR
4	S–HETERO
5	N–HETERO
6	O–HETERO
7	N,C,S
8	N,C,O
9	C,N
11	N,O (S)
32 12	OH, SH
33 0	S,O (N)
1	O,S
2	AMINES
3	PHOSPHORUS
4	METALS
5	BORANES
6	SILANES
7	MISC.

ALKYNYL

8	ARYL
9	CYCLOALKYL
11	HALOGENS
33 12	CARBONYL
34 0	COOR
1	S–COOR
2	S–HETERO
3	N–HETERO
4	O–HETERO
5	N,C,S
6	N,C,O
7	C,N
8	N,O (S)
9	OH, SH
11	S,O (N)
34 12	O,S
35 0	AMINES
1	PHOSPHORUS
2	METALS
3	BORANES
4	SILANES
5	MISC.

ARYL

6	ARYL
7	CYCLOALKYL
8	HALOGENS
9	CARBONYL
11	COOR
35 12	S–COOR
36 0	S–HETERO
1	N–HETERO
2	O–HETERO
3	N,C,S
4	N,C,O
5	C,N
6	N,O (S)
7	OH, SH
8	S,O (N)
9	O,S
11	AMINES
36 12	PHOSPHORUS
37 0	METALS
1	BORANES
2	SILANES
3	MISC.

CYCLOALKYL

4	CYCLOALKYL
5	HALOGENS
6	CARBONYL
7	COOR
8	S–COOR
9	S–HETERO
11	N–HETERO
37 12	O–HETERO
38 0	N,C,S
1	N,C,O
2	C,N
3	N,O (S)
4	OH, SH
5	S,O (N)
6	O,S
7	AMINES
8	PHOSPHORUS
9	METALS
11	BORANES
38 12	SILANES
39 0	MISC.

S–HETERO

44 0	S–HETERO
1	N–HETERO
2	O–HETERO
3	N,C,S
4	N,C,O
5	C,N
6	N,O (S)
7	OH, SH
8	S,O (N)
9	O,S
11	AMINES
44 12	PHOSPHORUS
45 0	METALS
1	BORANES
2	SILANES
3	MISC.

N–HETERO

4	N–HETERO
5	O–HETERO
6	N,C,S
7	N,C,O
8	C,N
9	N,O (S)
11	OH, SH
45 12	S,O (N)
46 0	O,S
1	AMINES
2	PHOSPHORUS
3	METALS
4	BORANES
5	SILANES
6	MISC.

O–HETERO

7	O–HETERO
8	N,C,S
9	N,C,O
11	C,N
46 12	N,O (S)
47 0	OH, SH
1	S,O (N)
2	O,S
3	AMINES
4	PHOSPHORUS
5	METALS
6	BORANES
7	SILANES
8	MISC.

N,C,S

9	N,C,S
11	N,C,O
47 12	C,N
48 0	N,O (S)
1	OH, SH
2	S,O (N)
3	O,S
4	AMINES
5	PHOSPHORUS
6	METALS
7	BORANES
8	SILANES
9	MISC.

N,C,O

11	N,C,O
48 12	C,N
49 0	N,O (S)
1	OH, SH
2	S,O (N)
3	O,S
4	AMINES
5	PHOSPHORUS
6	METALS
7	BORANES
8	SILANES
9	MISC.

AD 4005 45

74 75 76 77 78 79 80

O,S

52	
	O,S
6	AMINES
	PHOSPHORUS
7	METALS
8	BORANES
9	SILANES
11	MISC.

AMINES

	AMINES
52 12	PHOSPHORUS
53 0	METALS
1	BORANES
2	SILANES
3	MISC.

PHOSPHORUS

53	
	PHOSPHORUS
4	METALS
5	BORANES
6	SILANES
7	MISC.

RING SYSTEM (GENERAL)

4292.2	6	RINGS–2
4292.4	7	RINGS–3
4292.5	8	RINGS–4
4292.7	9	RINGS–5
4292.9	11	RINGS–6+
3298.29	54 12	N–RINGS–1
3298.30	55 0	N–RINGS–2
3298.31	1	N–RINGS–3+
4863.28	2	S–RINGS–1
4863.29	3	S–RINGS–2+
3475.24	4	O–RINGS–1
3475.25	5	O–RINGS–2+
3089.25	6	MISC.–HETERO RINGS–1
3089.75	7	MISC.–HETERO RINGS–2

RING INDEX NO.

56	57	58	59
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

RING INDEX NAME

1.

FRAGMENT RELATIONSHIPS

ARYL

6	ARYL
7	CYCLOALKYL
8	HALOGENS
9	CARBONYL
11	COOR
35 12	S–COOR
36 0	S–HETERO
1	N–HETERO
2	O–HETERO
3	N,C,S
4	N,C,O
5	C,N
6	N,O (S)
7	OH, SH
8	S,O (N)
9	O,S
11	AMINES
36 12	PHOSPHORUS
37 0	METALS
1	BORANES
2	SILANES
3	MISC.

CYCLOALKYL

4	CYCLOALKYL
5	HALOGENS
6	CARBONYL
7	COOR
8	S–COOR
9	S–HETERO
11	N–HETERO
37 12	O–HETERO
38 0	N,C,S
1	N,C,O
2	C,N
3	N,O (S)
4	OH, SH
5	S,O (N)
6	O,S
7	AMINES
8	PHOSPHORUS
9	METALS
11	BORANES
38 12	SILANES
39 0	MISC.

HALOGENS

1	HALOGENS
2	CARBONYL
3	COOR
4	S–COOR
5	S–HETERO
6	N–HETERO
7	O–HETERO
8	N,C,S
9	N,C,O
11	C,N
12	N,O (S)
39	OH, SH
40 0	S,O (N)
1	O,S
2	AMINES
3	PHOSPHORUS
4	METALS
5	BORANES
6	SILANES
7	MISC.

CARBONYL

	CARBONYL
8	COOR
9	S–COOR
11	S–HETERO
40 12	N–HETERO
41 0	O–HETERO
1	N,C,S
2	N,C,O
3	C,N
	N,O (S)
	OH, SH
4	S,O (N)
	O,S
	AMINES
5	PHOSPHORUS
6	METALS
7	BORANES
8	SILANES
9	MISC.

S–COOR

11	COOR
41 12	S–COOR
42 0	S–HETERO
1	N–HETERO
2	O–HETERO
3	N,C,S
	N,C,O
	C,N
	N,O (S)
	OH, SH
	S,O (N)
4	O,S
5	AMINES
6	PHOSPHORUS
7	METALS
8	BORANES
9	SILANES
11	MISC.

COOR

	S–COOR
42 12	S–HETERO
43 0	N–HETERO
1	O–HETERO
2	N,C,S
3	N,C,O
4	C,N
	N,O (S)
	OH, SH
	S,O (N)
5	O,S
6	AMINES
7	PHOSPHORUS
8	METALS
9	BORANES
11	SILANES
43 12	MISC.

N,C,S

9	N,C,S
11	N,C,O
47 12	C,N
48 0	N,O (S)
1	OH, SH
2	S,O (N)
3	O,S
4	AMINES
5	PHOSPHORUS
6	METALS
7	BORANES
8	SILANES
9	MISC.

N,C,O

11	N,C,O
48 12	C,N
49 0	N,O (S)
1	OH, SH
2	S,O (N)
3	O,S
4	AMINES
5	PHOSPHORUS
6	METALS
7	BORANES
8	SILANES
9	MISC.

C,N

11	C,N
49 12	N,O (S)
50 0	OH, SH
1	S,O (N)
2	O,S
3	AMINES
4	PHOSPHORUS
5	METALS
6	BORANES
7	SILANES
8	MISC.

N,O (S)

	N,O (S)
	OH, SH
9	S,O (N)
	O,S
11	AMINES
50 12	PHOSPHORUS
51 0	METALS
1	BORANES
2	SILANES
3	MISC.

OH, SH

51 4	OH, SH
	S,O (N)
	O,S
5	AMINES
6	PHOSPHORUS
7	METALS
8	BORANES
9	SILANES
11	MISC.

S,O (N)

	S,O (N)
51 12	O,S
52 0	AMINES
1	PHOSPHORUS
2	METALS
3	BORANES
4	SILANES
5	MISC.

AMINES

	AMINES
52 12	PHOSPHORUS
53 0	METALS
1	BORANES
2	SILANES
3	MISC.

PHOSPHORUS

53	
	PHOSPHORUS
4	METALS
5	BORANES
6	SILANES
7	MISC.

METALS

8	METALS
9	BORANES
11	SILANES
53 12	MISC.

BORANES

54 0	BORANES
1	SILANES
2	MISC.

SILANES

54 3	SILANES
4	MISC.

MISC.

54 5	MISC.

X NO.

59
0
1
2
3
4
5
6
7
8
9

RING INDEX NAME

OPEN-ENDED SECTION

COL & ROW

SECTION

2

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