Chemistry of Thiophene 1,1-Dioxides

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November 26, 2014

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- Pyrolysis

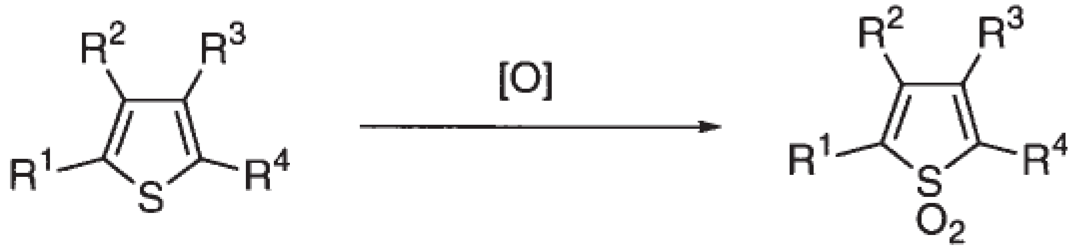
Thiophene 1,1-dioxides

- Thiophene 1,1-dioxides are most commonly prepared by oxidation of thiophenes. Thiophene oxides, where two pairs of lone pair electrons are consumed for bond formation with oxygen atoms, are no longer aromatic.

- As unsaturated sulfones, they serve as dienophiles, 1,3-dipolarophiles, and Michael acceptors.

- They, as dienes, undergo a wide variety of synthetically useful Diels-Alder reactions and occasionally undergo even [4+6] cycloadditions.

Synthesis: *By Oxidation of Thiophenes*



- **For synthesis, organic peracids are the most common reagents.**

Such as *peracetic, perbenzoic, m-chloroperbenzoic, and trifluoroperacetic acids, and, in rare cases, p-nitroperbenzoic and monoperphthalic acids*

- **Dimethyldioxirane has been shown to be very useful for this oxidation.**

- **Many inorganic oxidizing reagents**

$NaBO_3 \cdot 4H_2O/AcOH$ *and* $F_2/H_2O/CH_3CN$ *produce a variety of thiophene dioxides in better yields*

Synthesis: *By Oxidation of Thiophenes*

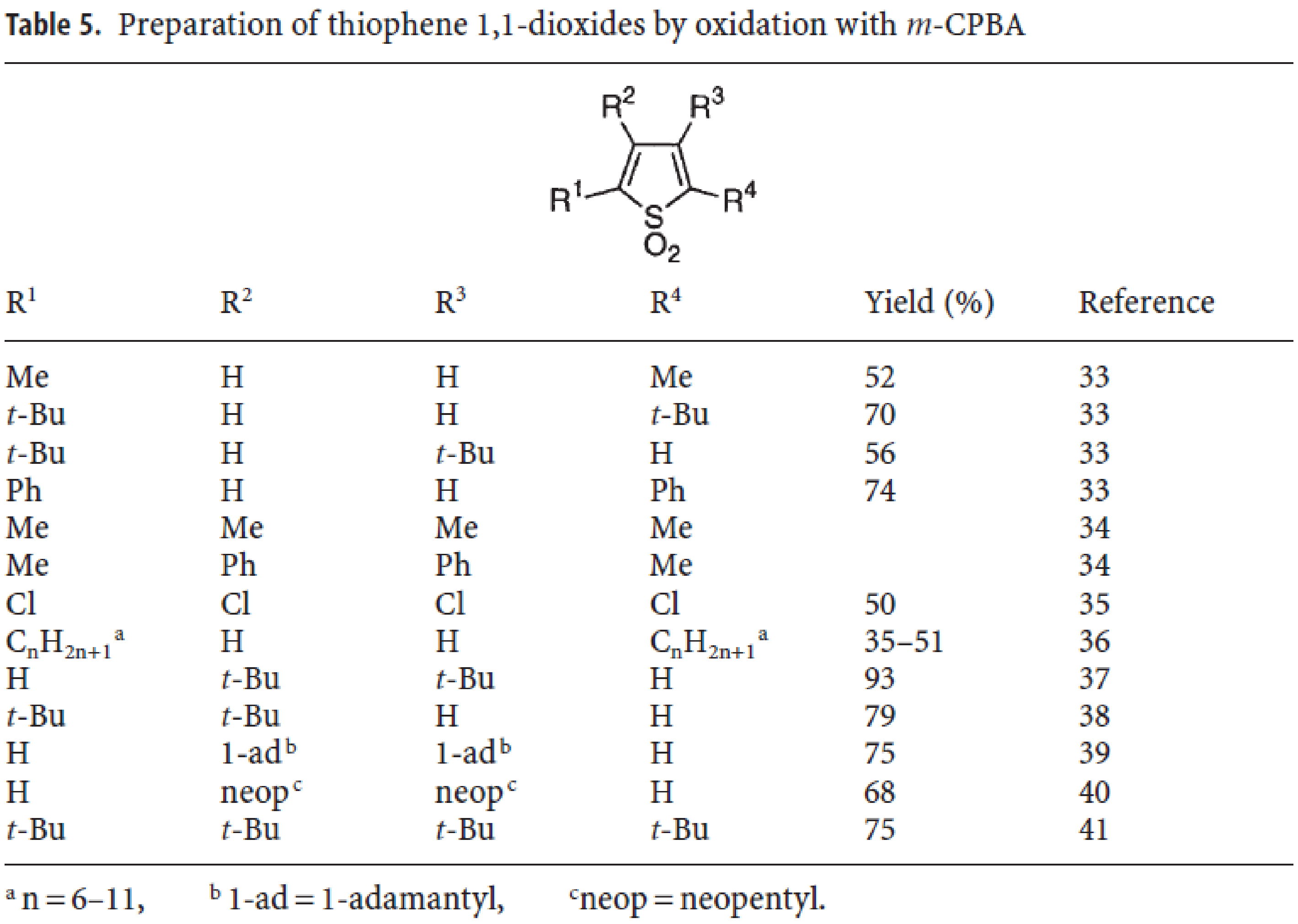


Table 5. Preparation of thiophene 1,1-dioxides by oxidation with *m*-CPBA

R^1	R^2	R^3	R^4	Yield (%)	Reference
Me	H	H	Me	52	33
t-Bu	H	H	*t*-Bu	70	33
t-Bu	H	*t*-Bu	H	56	33
Ph	H	H	Ph	74	33
Me	Me	Me	Me		34
Me	Ph	Ph	Me		34
Cl	Cl	Cl	Cl	50	35
C_nH_{2n+1}[a]	H	H	C_nH_{2n+1}[a]	35–51	36
H	*t*-Bu	*t*-Bu	H	93	37
t-Bu	*t*-Bu	H	H	79	38
H	1-ad[b]	1-ad[b]	H	75	39
H	neop[c]	neop[c]	H	68	40
t-Bu	*t*-Bu	*t*-Bu	*t*-Bu	75	41

[a] n = 6–11, [b] 1-ad = 1-adamantyl, [c] neop = neopentyl.

Synthesis: *By Oxidation of Thiophenes*

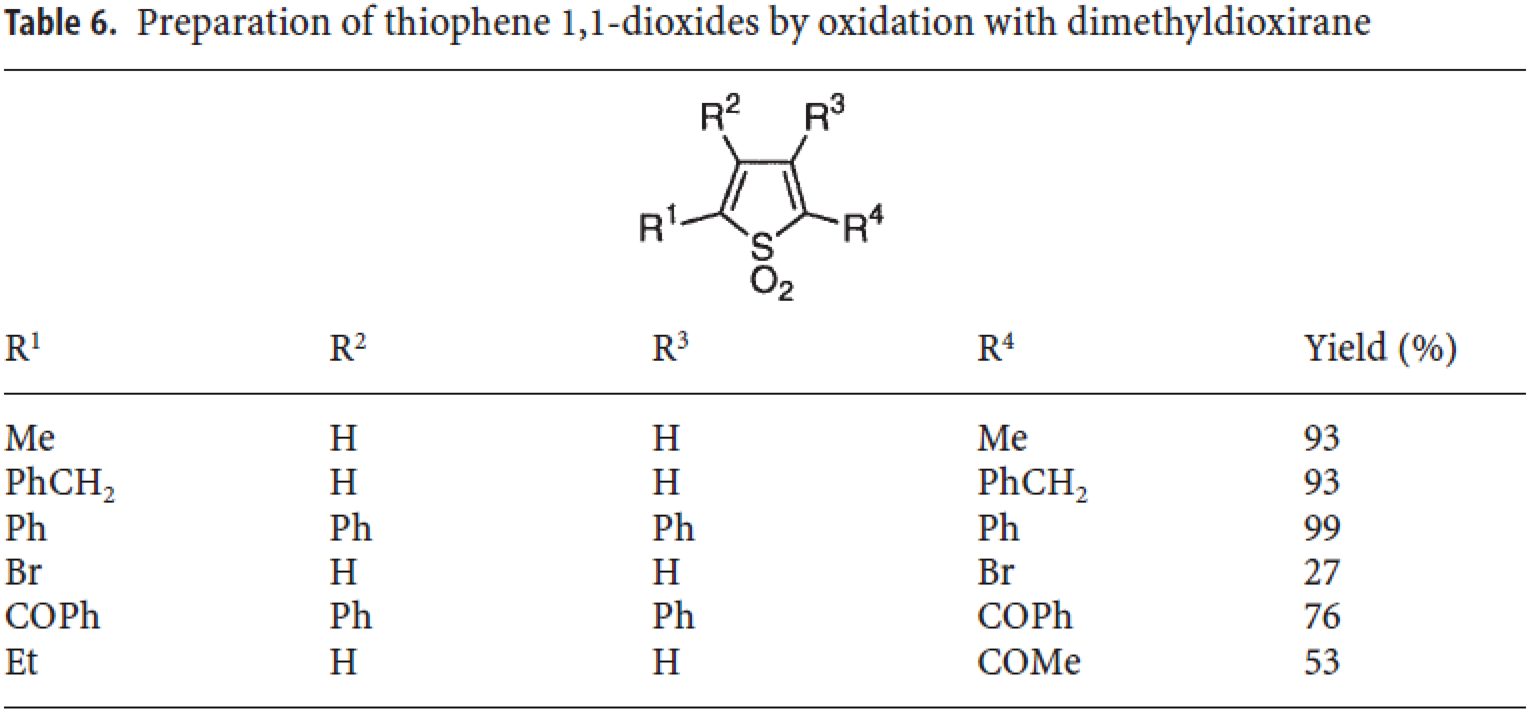


Table 6. Preparation of thiophene 1,1-dioxides by oxidation with dimethyldioxirane

R^1	R^2	R^3	R^4	Yield (%)
Me	H	H	Me	93
$PhCH_2$	H	H	$PhCH_2$	93
Ph	Ph	Ph	Ph	99
Br	H	H	Br	27
COPh	Ph	Ph	COPh	76
Et	H	H	COMe	53

- The oxidation is carried out under neutral conditions.
- In addition, workup procedure is very simple since the dimethyldioxirane isconverted into acetone.
- The oxidation is applicable to thiophenes carrying electron-withdrawing substituent(s), which resist oxidation with peracids

Miyahara. Y, Inazu. T. *Tetrahedron. Lett*. (**1990**) 31:5955

Synthesis: *By Oxidation of Thiophenes*

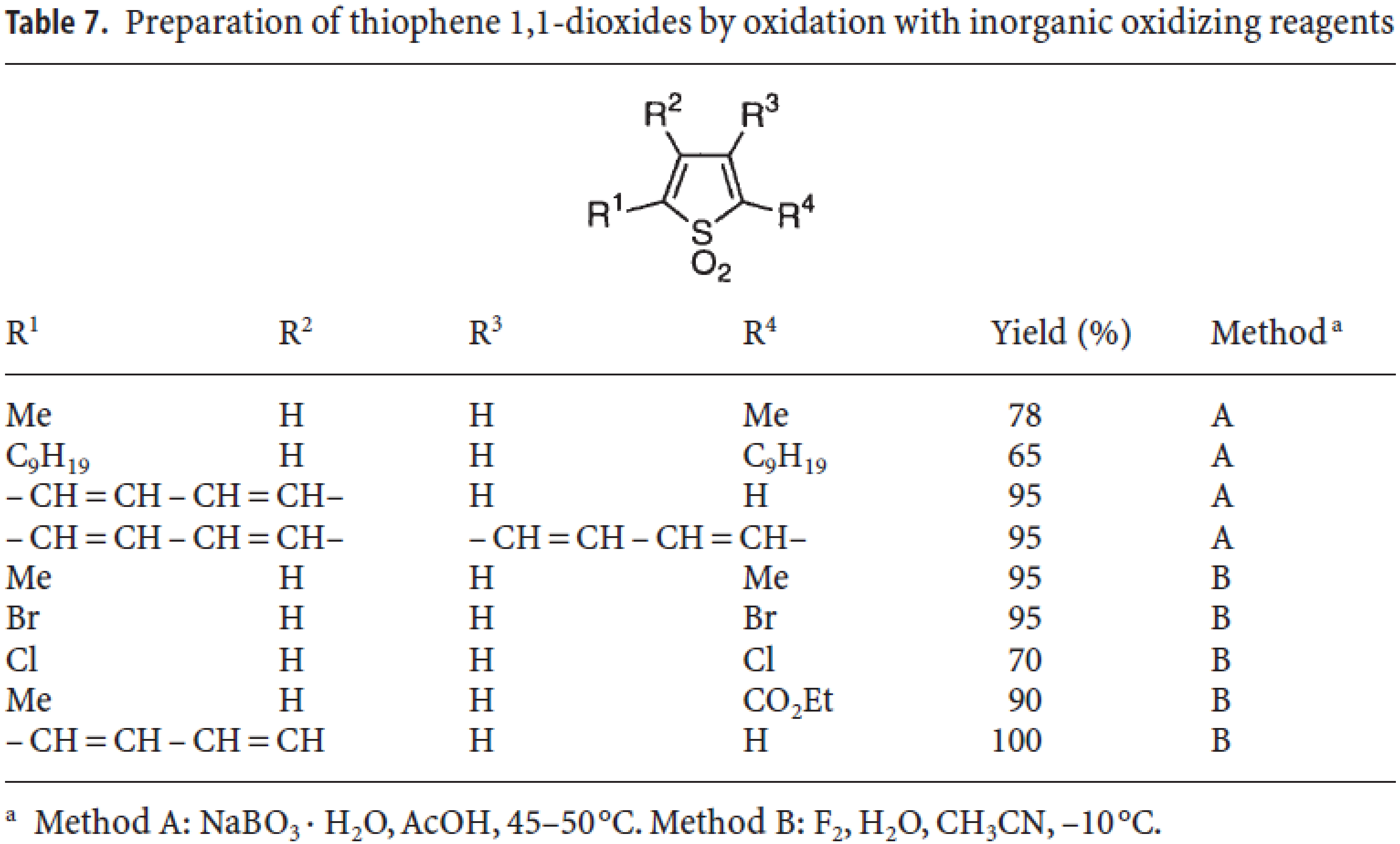


Table 7. Preparation of thiophene 1,1-dioxides by oxidation with inorganic oxidizing reagents

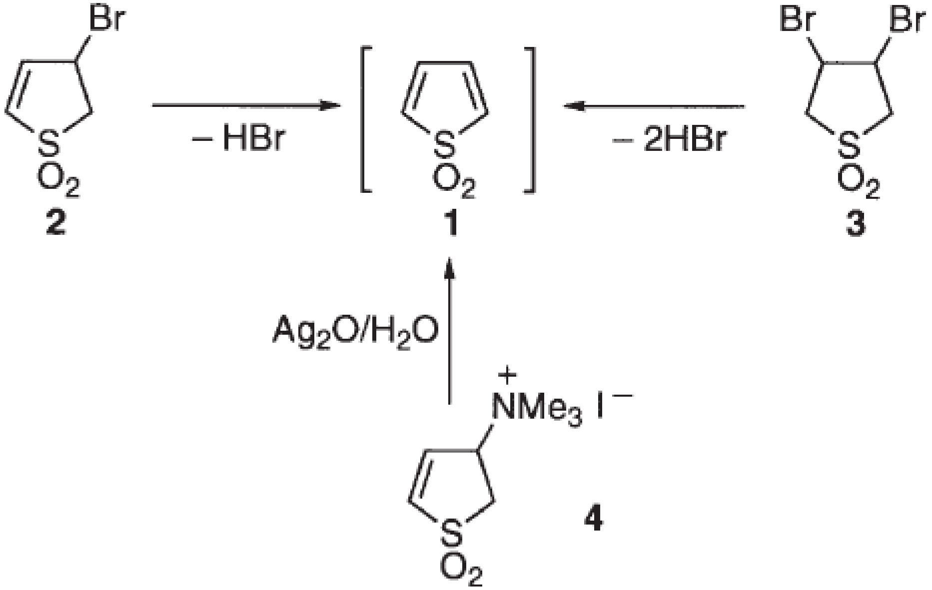
R^1	R^2	R^3	R^4	Yield (%)	Method[a]
Me	H	H	Me	78	A
C_9H_{19}	H	H	C_9H_{19}	65	A
–CH=CH–CH=CH–		H	H	95	A
–CH=CH–CH=CH–		–CH=CH–CH=CH–		95	A
Me	H	H	Me	95	B
Br	H	H	Br	95	B
Cl	H	H	Cl	70	B
Me	H	H	CO_2Et	90	B
–CH=CH–CH=CH		H	H	100	B

[a] Method A: $NaBO_3 \cdot H_2O$, AcOH, 45–50 °C. Method B: F_2, H_2O, CH_3CN, –10 °C.

McKillop. A, Kemp, D. *Tetrahedron*(**1989**) 45,3299

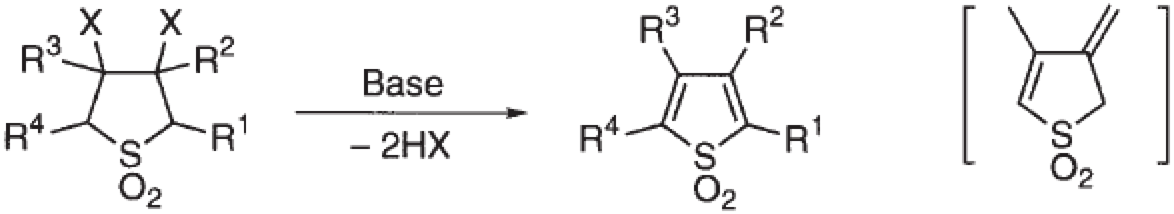
Rozen. S, Bareket. Y. *J. Chem. Soc. Chem. Commun*. (**1994**) 1959

Synthesis: *From Dihydrothiophene and Tetrahydrothiophene 1,1- dioxide*



Chou. T-S, Chen. M-H. *Heterocycles* (**1987**) 26:2829
Bailey. WJ, Cummin.s EW. *J. Am. Chem. Soc.* (**1954**) 76:1932

Synthesis: *From Dihydrothiophene and Tetrahydrothiophene 1,1- dioxide*



5 **6** **7**

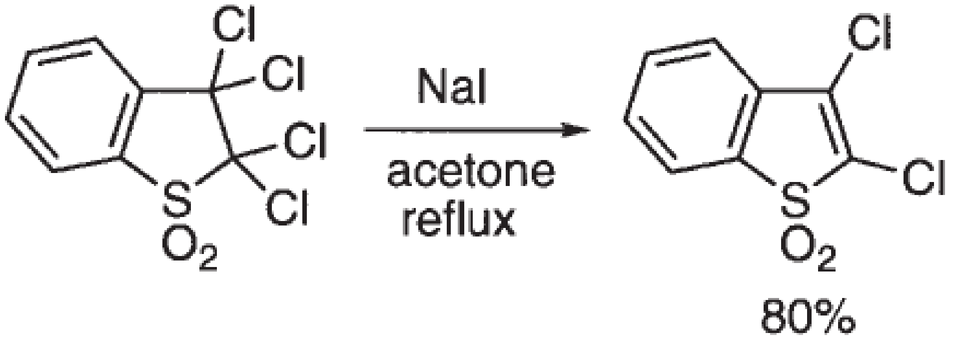
X = Cl or Br

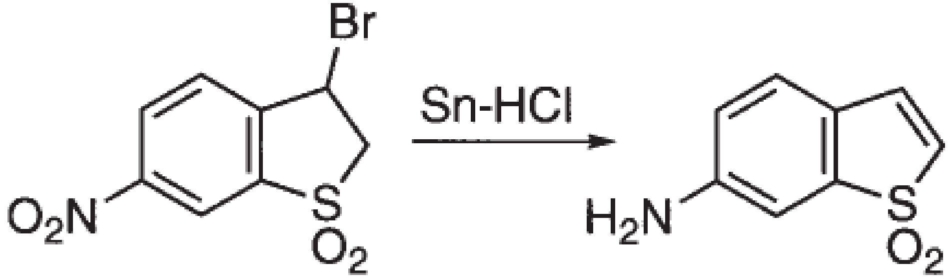
a: $R^2 = R^4 = H$, $R^1 = R^3 =$ *t*-butyl
b: $R^1 = R^4 = H$, $R^2 = R^3 = Cl$; 82%
c: $R^1 = R^4 = H$, $R^2 = R^3 = Me$
d: $R^1 = R^2 = R^3 = R^4 = Me$

Bluestone. H, Rimber .R, Berkey. R,Mandel. Z. *J. Org. Chem*. **1951**, 26, 2151

Synthesis: *From Dihydrothiophene and Tetrahydrothiophene 1,1- dioxide*

Benzo[b]thiophen 1,1-dioxides:

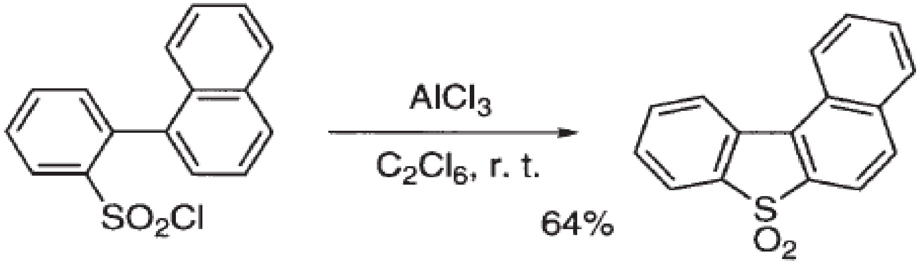




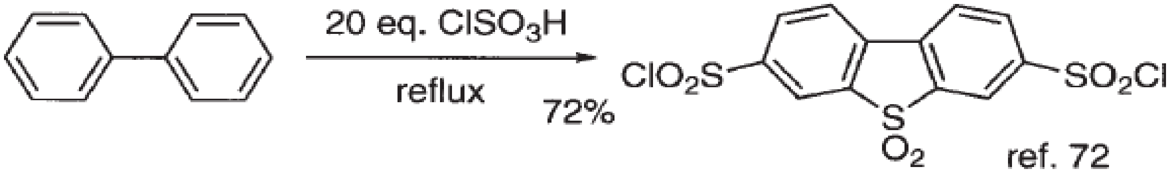
Raasch MS (1980) J Org Chem 45:2151

Synthesis: *By Intramolecular Cyclization*

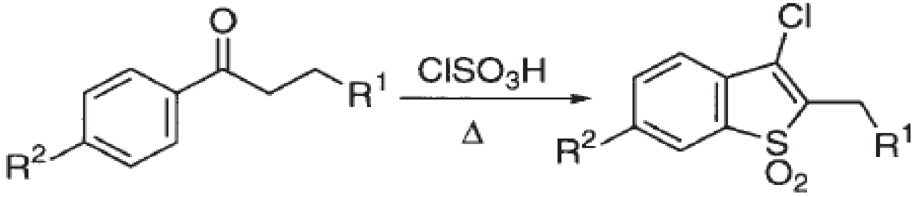
Friedel-Crafts type reactions



ref. 67



ref. 72



$R^1 = R^2 = H$

$R^1 = H$, $R^2 = Cl$: 64%

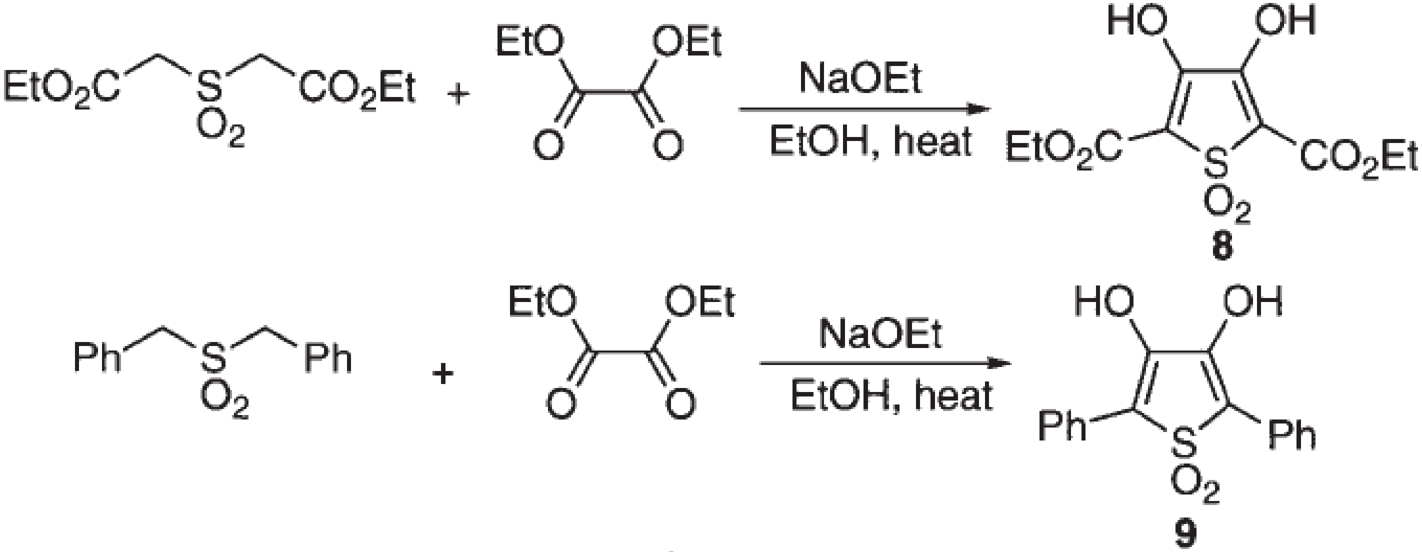
$R^1 = NMe_2$, $R^2 = H$: 46%

R^1 = 1-morpholyl, $R^2 = H$: 51%

ref. 73,74

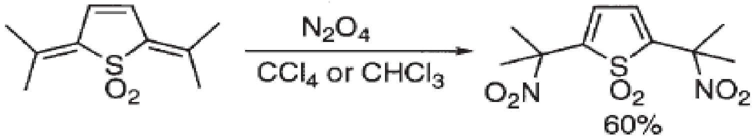
Synthesis: *By Intramolecular Cyclization*

Hinsberg type condensation:

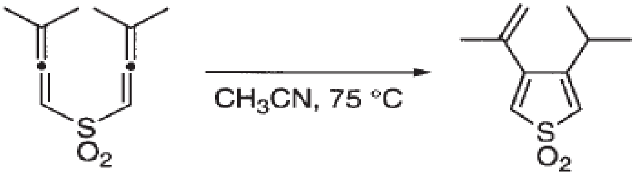


Eastman. RH, Wagner. RM. J. Am. Chem. Soc. (**1949**) 71:4089

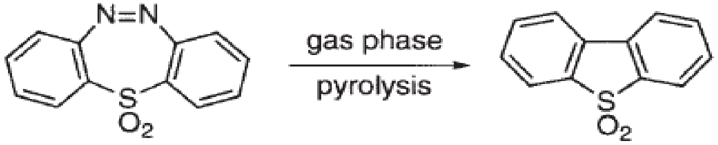
Synthesis: Miscellaneous



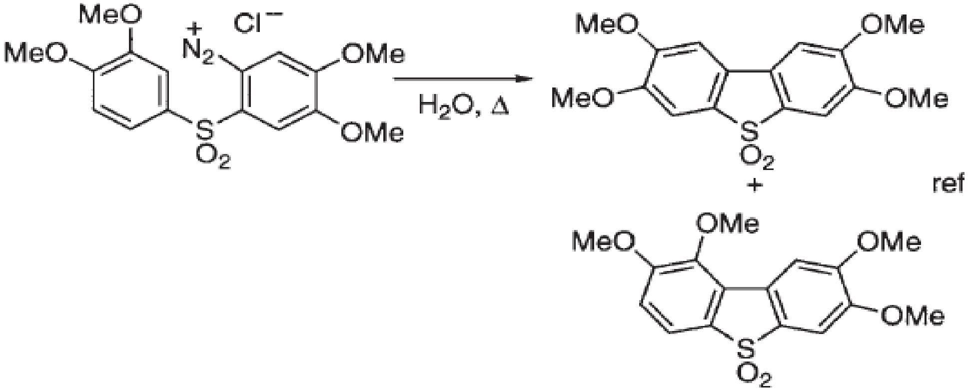
ref.90



ref. 91



ref. 92



ref. 93-95

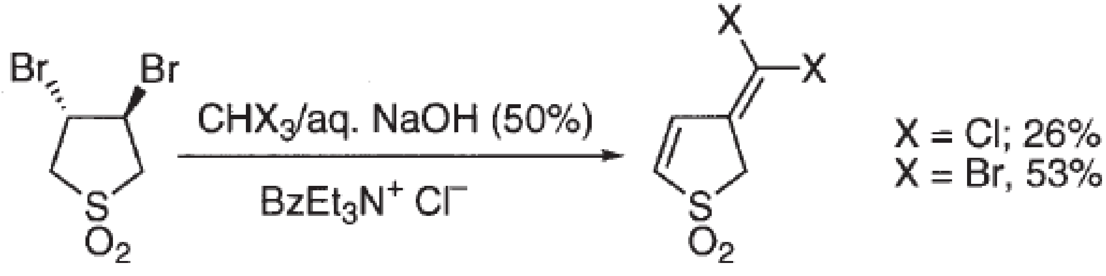
Reactivities:

- ***As unsaturated sulfones, many of them are thermally labile .because of easy dimerization and are highly reactive toward other substrates.***

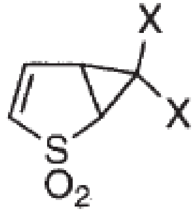
- ***Monocyclic thiophene dioxides and benzo[b]thiophene dioxides serve as a 2π-component toward dienes and 1,3-dipoles, and monocyclic derivatives also act as dienes toward numerous 2π- and 6π-components.***

- ***In addition, they undergo a wide variety of reactions with many other reagents. These are the very properties that make them synthetically most versatile.***

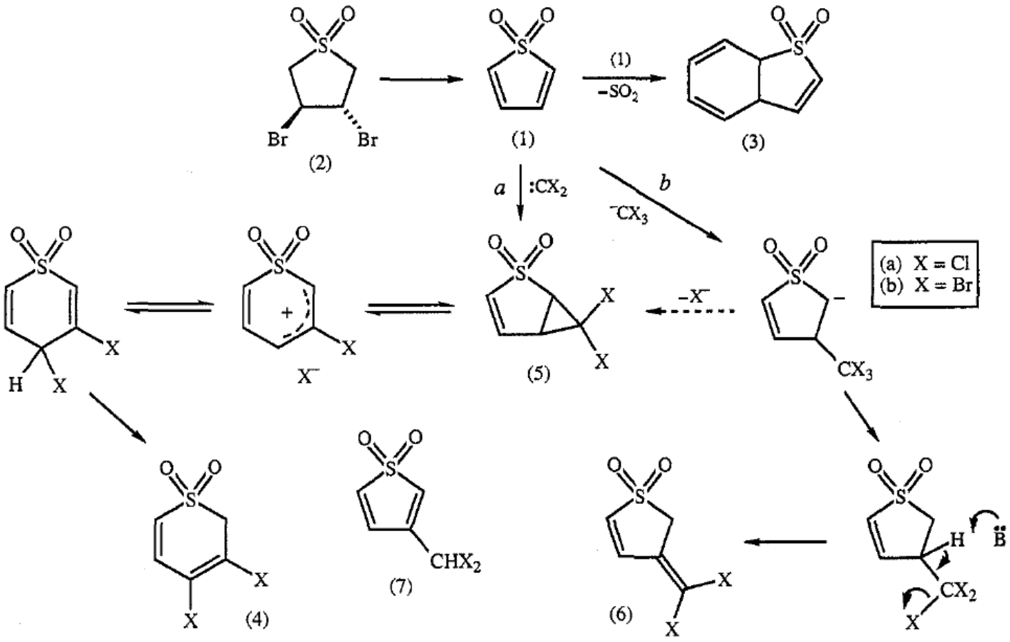
Reactivities: *[1+2] Cycloaddition*



3 **15**



16

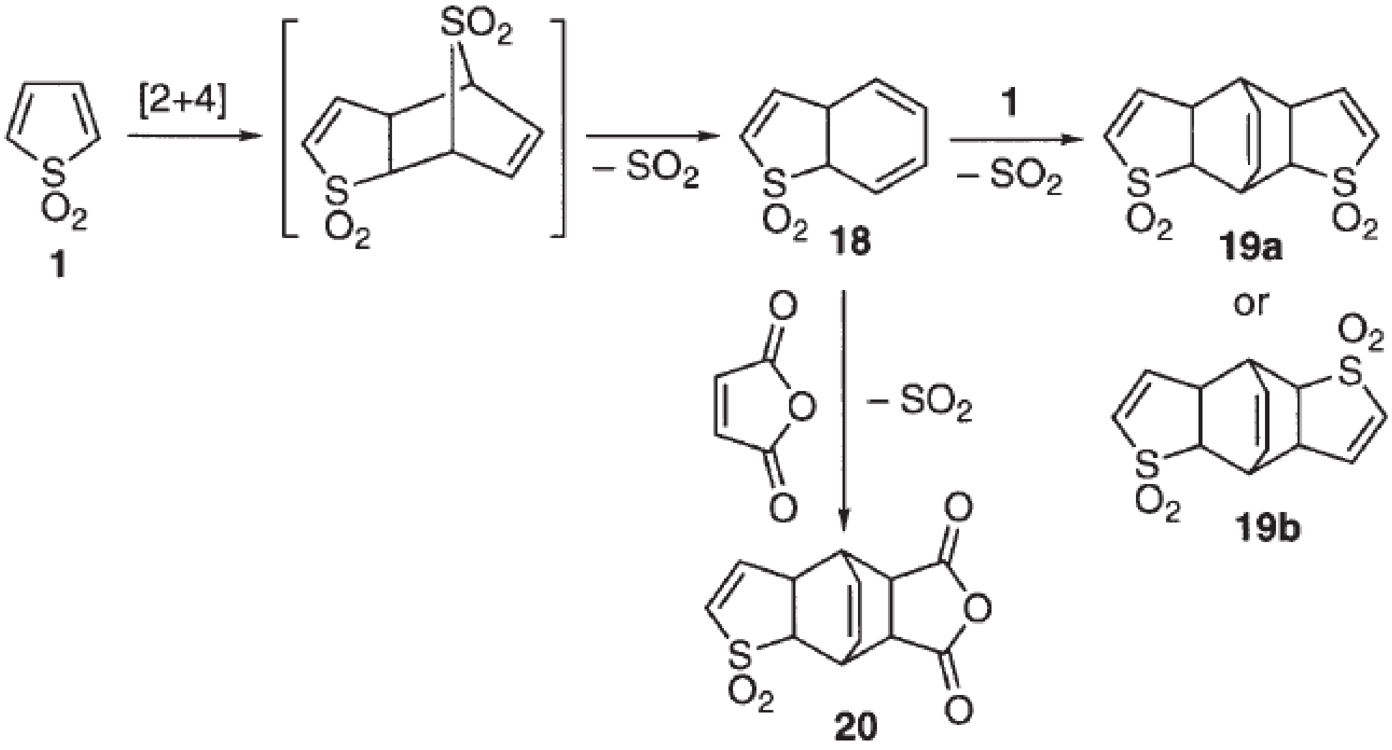


Dent. BR,Gainsford. GJ. *Aust J Chem* (**1989**) 42:1307

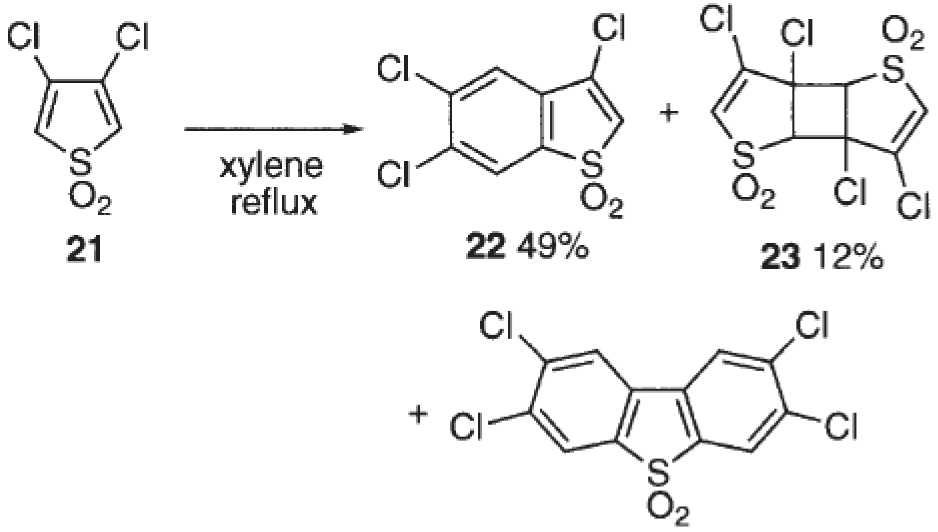
Reactivities: *[2+2] and [2+4] Cyclodimerization*

Thiophene 1,1-dioxides undergo cyclodimerization in two ways.

- Thermally labile anthiophene 1,1-dioxides undergo [2+4] dimerization, one molecule acting as a dienophile and the other acting as a diene;
- Thermally stable thiophene 1,1-dioxides undergo [2+2] dimerization on photoirradiation.



Reactivities: *[2+2] and [2+4] Cyclodimerization*

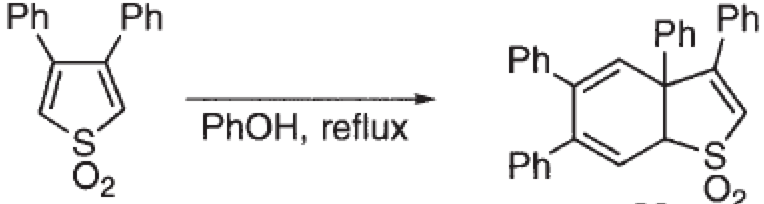


21

22 49%

23 12%

24

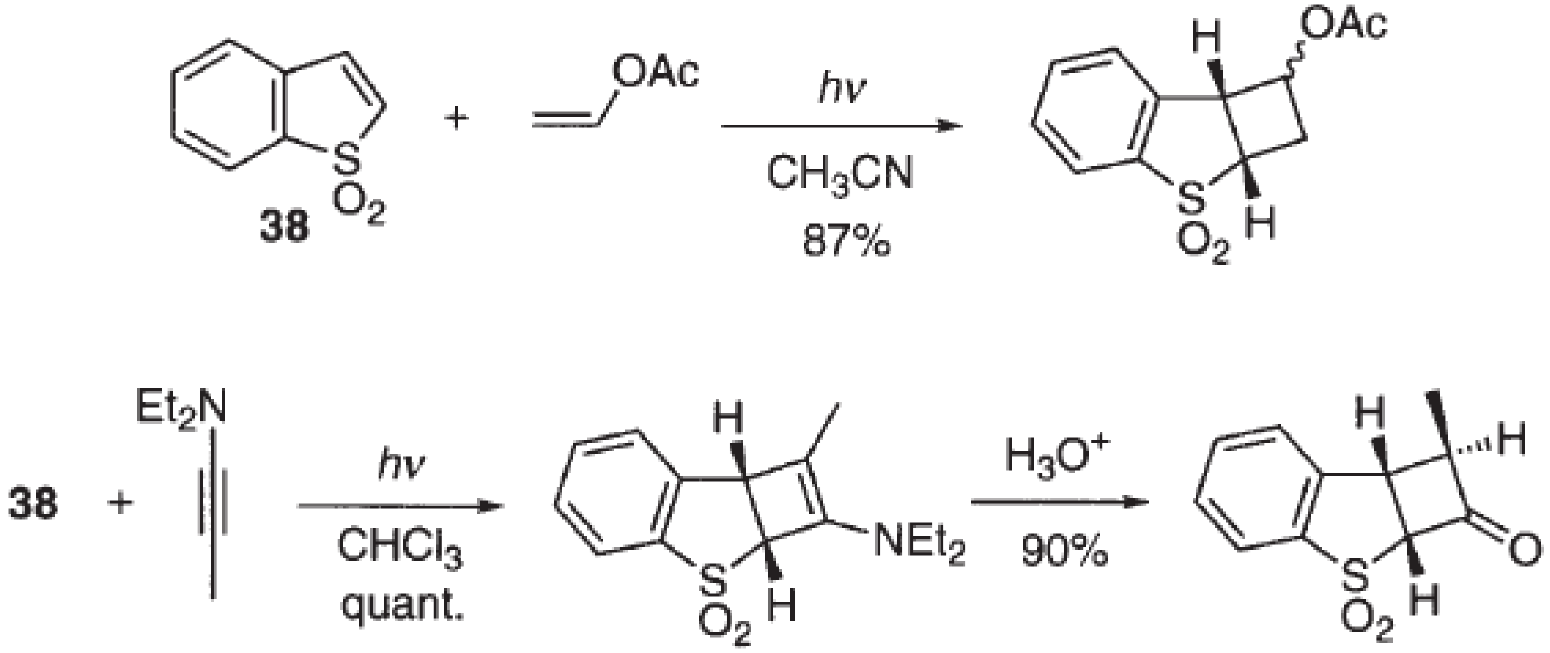


25

26
62%

Bluestone. H, Bimber. R, Berkley. R,Mandel .Z. *J Org Chem* (**1960**) 26:346
Overberger. CG,Whelan. JM. *J Org Chem* (**1961**) 26:4328

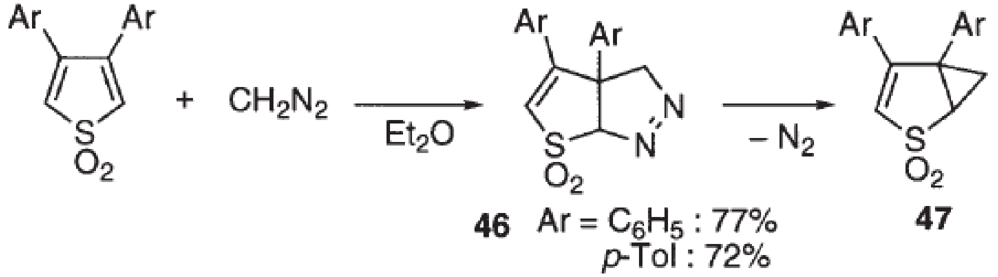
Reactivities: *[2+2] Photocycloaddition*

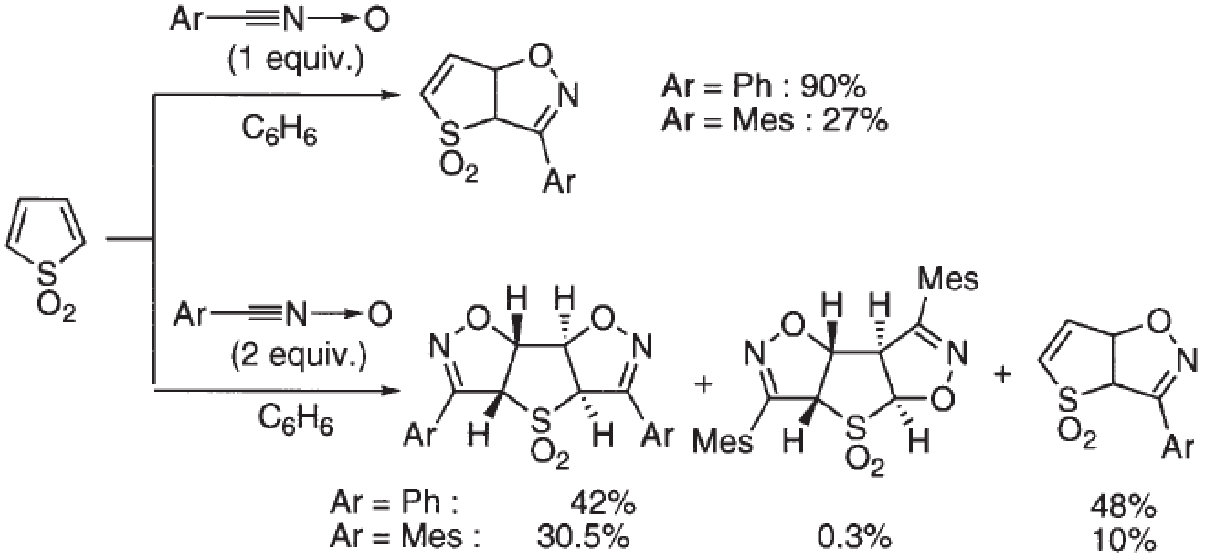


Ikeda. M,Uno. T,Homma. K, Ono. K, Tamura. Y. *Synth Commun* (**1980**) 10:437
Eisch. J.J,Galle. J.E,Hallenbeck. L.E. *J Org Chem* (**1982**) 47:1608

Reactivities: *1,3-Dipolar Cycloaddition*

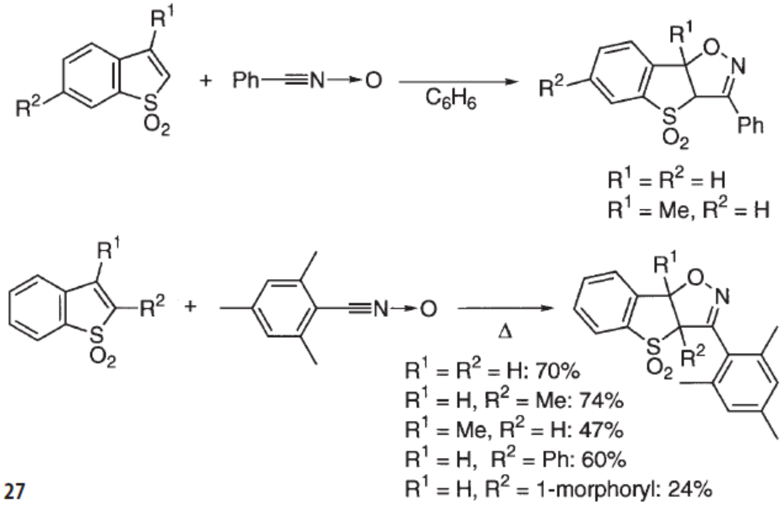
In most cases, 1,3-dipolar cycloadditions is regioselective



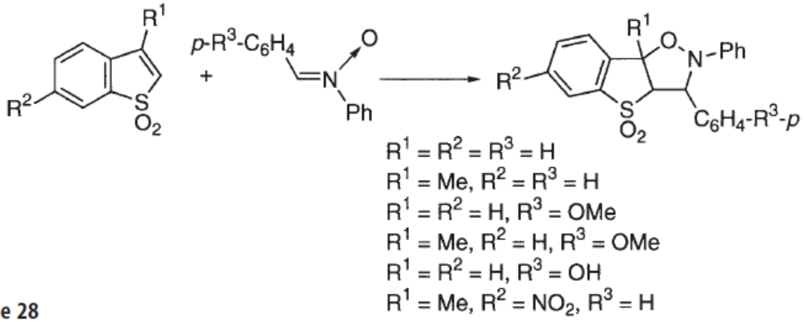


Albini FM, Ceva P,Mascherpa A, Albini E, Caramella P.*Tetrahedron* (**1982**) 24:3629

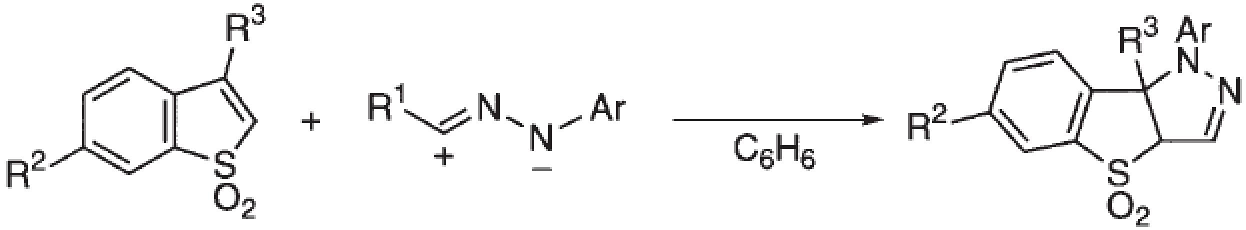
Reactivities: *1,3-Dipolar Cycloaddition*



Scheme 27



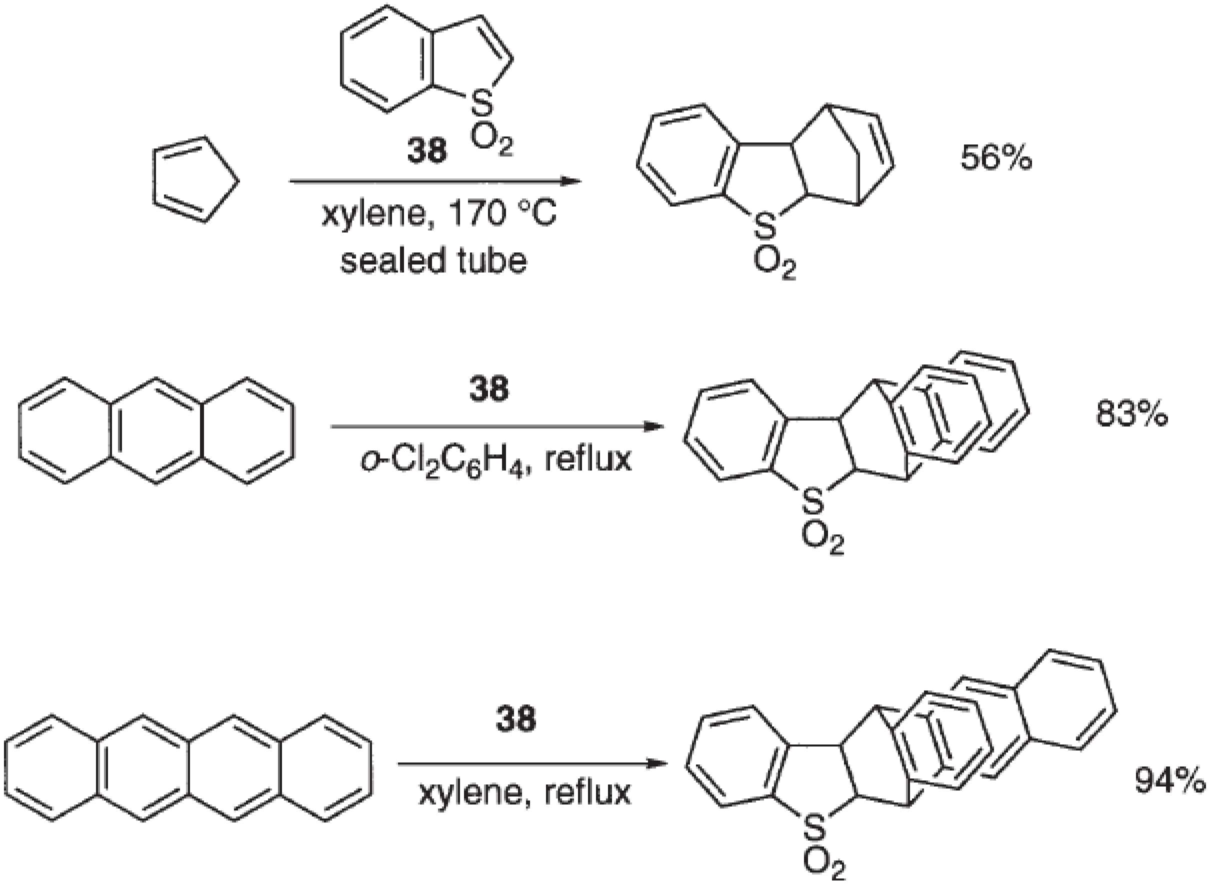
Scheme 28



Bougrin K, Soufiaoui M, Loupy A, Jacquault P . *New J Chem* .(**1995**) 19:213

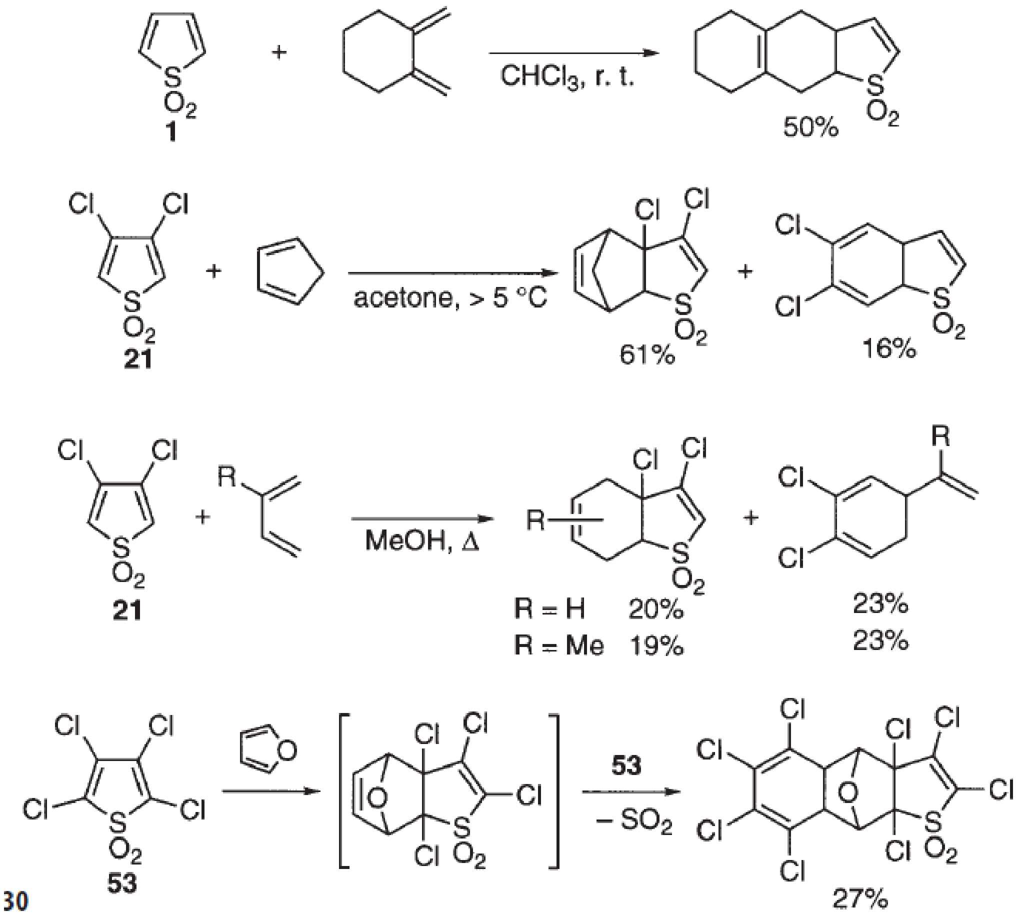
Reactivities: *[2+4] Cycloaddition (Thiophene Dioxides as 2π Component)*

As a 4π *component toward dienophiles*



Reactivities: *[2+4] Cycloaddition (Thiophene Dioxides as 2π Component)*

Behave as a dienophile toward 4π components



Reactivities: *[4+2] Cycloaddition (Thiophene Dioxide as 4π Component)*

Thiophene dioxides act as a *4π component toward a wide variety of dienophiles.*

- Due to the electron-withdrawing properties of the sulfonyl group, they are rather electron-deficient dienes. Therefore, dienophiles do not necessarily require activation by electron-withdrawing group(s) in order to undergo cycloaddition with most thiophene dioxides.

- The electron demand of the Diels-Alder reactions of thiophene dioxides often becomes inverse to that of common Diels- Alder reactions.Even electron-rich alkenes can then take part in the Diels-Alder reactions with thiophene dioxides. This is one of the features that makes thiophene dioxides synthetically important.

- Although the Diels-Alder reactions of many thiophene dioxides have been examined in great detail, the most extensively investigated are those with tetrachlorothiophene 1,1-dioxide**. This is** easily obtainable by oxidation of tetrachlorothiophene and is thermally stable, but is very reactive and can react with a wide variety of alkenic dienophiles.

- [4+2] cycloadditions with alkenic dienophiles are classified for convenience into six categories according to the structures of the final products.

Reactivities:

[4+2] Cycloaddition with Alkenic Dienophiles

Category A: 1,3-Cyclohexadiene-Forming Reactions

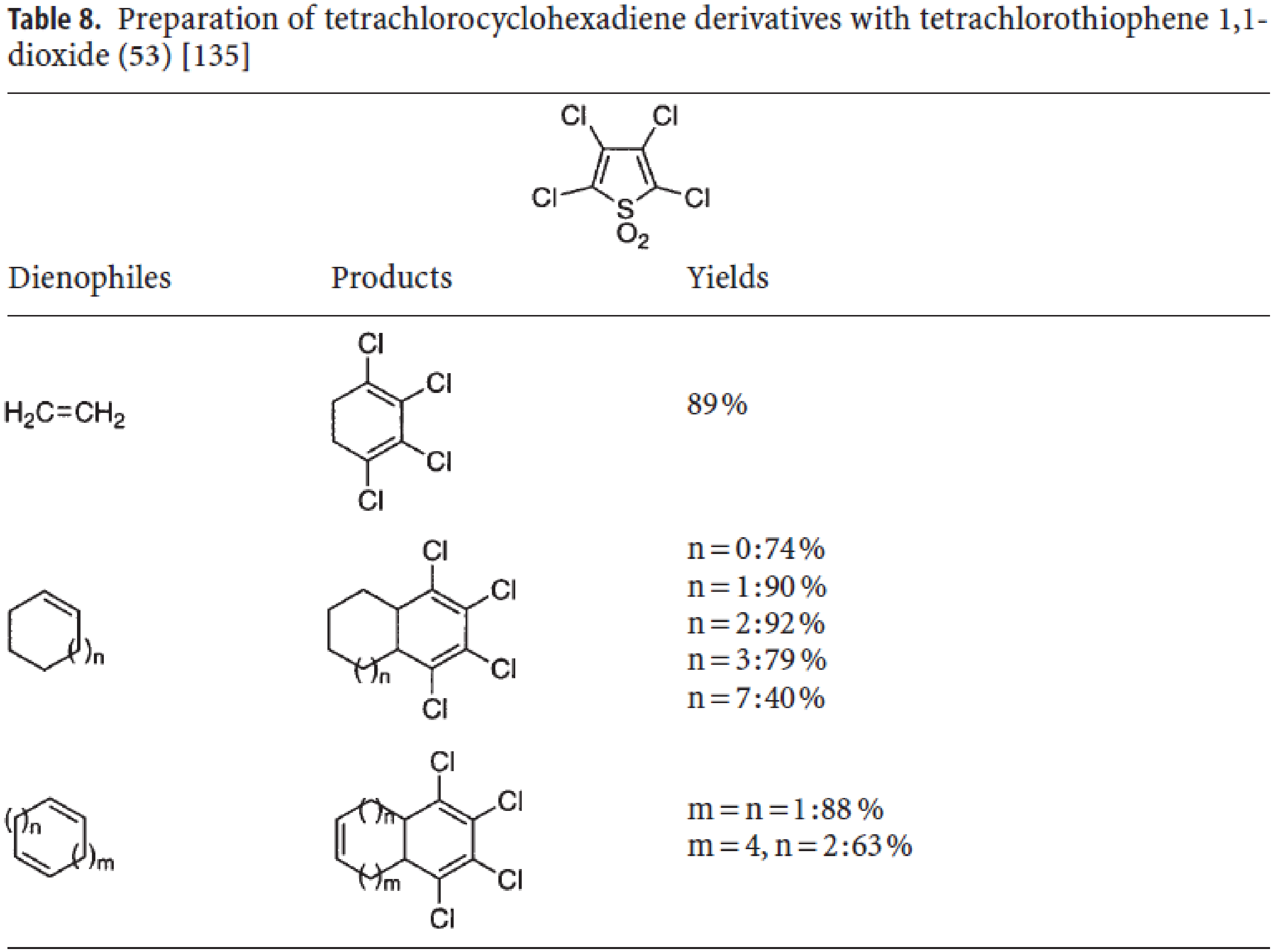
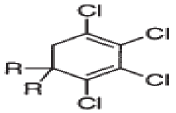
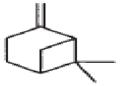
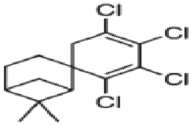
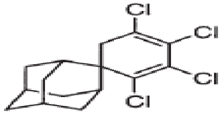
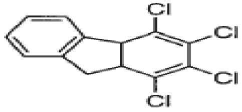
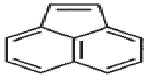
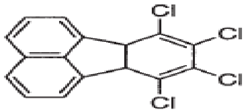
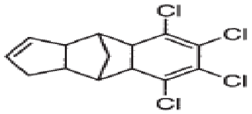
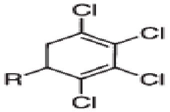


Table 8. Preparation of tetrachlorocyclohexadiene derivatives with tetrachlorothiophene 1,1-dioxide (53) [135]

Dienophiles	Products	Yields
$H_2C=CH_2$		89%
		n = 0 : 74% n = 1 : 90% n = 2 : 92% n = 3 : 79% n = 7 : 40%
		m = n = 1 : 88% m = 4, n = 2 : 63%

Raasch MS. *J Org Chem* (**1980**) 45:867

Table 8 (continued)

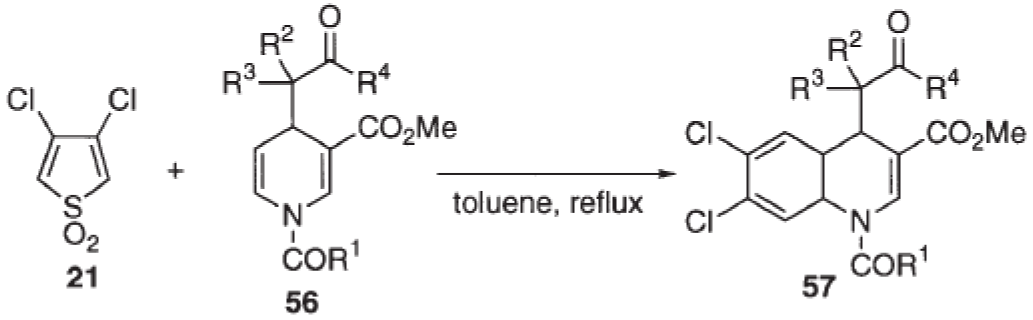
Dienophiles	Products	Yields
		R, R = $CH_2CH_2CH_2$:75 % R, R = $CH_2(CH_2)_3CH_2$:73 % R, R = $CH_2CH_2C(=CH_2)CH_2CH_2$:75 %
		74 %
		27 %
		80 %
		91 %
		65 %
		R = $CH_2CH_2C{\circ}CH$:70 % R = $CH_2(CH_2)_8CH_3$:88 % R = $CH_2(CH_2)_3C = CH_2$:69 % R = $CH_2(CH_2)_4C = CH_2$:69 % R = CO_2H : 68 % R = CO_2Me : 91 % R = CN : 83 % R = CH_2CO_2H : 78 % R = $CH_2(CH_2)_7CO_2H$: 78 % R = CH_2Br : 88 % R = CH_2NCS : 55 % R = 4-(1,2-methylenedioxy)benzyl : 75 % R = 2-pyridyl : 75 % R = *N*-pyrrolidonyl : 84 %

Raasch MS. *J Org Chem* (**1980**) 45:867

Reactivities:

[4+2] Cycloaddition with Alkenic Dienophiles

Category A: 1,3-Cyclohexadiene-Forming Reactions



R^1 = OEt, R^2 = R^3 = H, R^4 = Ph : 21%
R^1 = OEt, R^2 = H, R^3 = Ph, R^4 = OMe : 52%
R^1 = OEt, R^2 = R^3 = Me, R^4 = OMe : 36%
R^1 = NMe_2, R^2 = H, R^3 = Ph, R^4 = OMe : 54%
R^1 = NMe_2, R^2 = R^3 = Me, R^4 = OMe : 36%
R^1 = OEt, R^2 = R^3 = H, R^4 = Ph : 61%[a]
R^1 = OEt, R^2 = R^3 = H, R^4 = *p*-$MeOC_6H_4$: 21%[a]
R^1 = OMe, R^2 = H, R^3 = Me, R^4 = Et : 55%[a]
R^1 = OMe, R^2 = H, R^3 = Me, R^4 = Ph: 31%[a]
R^1 = OMe, R^2 = R^3 = R^4 = Me : 22%[a]
R^1 = NMe_2, R^2 = R^3 = R^4 = Me : 22%[a]

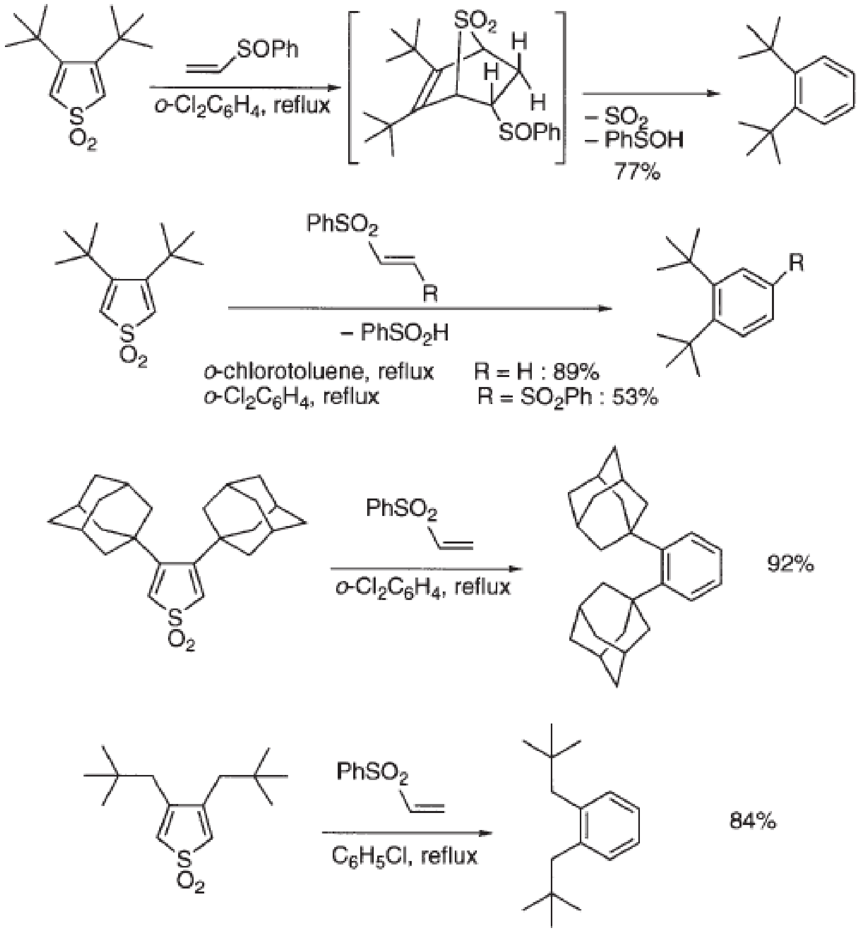
[a] Results in the presence of 2,6-lutidine

Akiba. K-Y, Ohtani .A,Yamamoto. Y. *J Org Chem* (**1986**) 51:5328

Reactivities:

[4+2] Cycloaddition with Alkenic Dienophiles

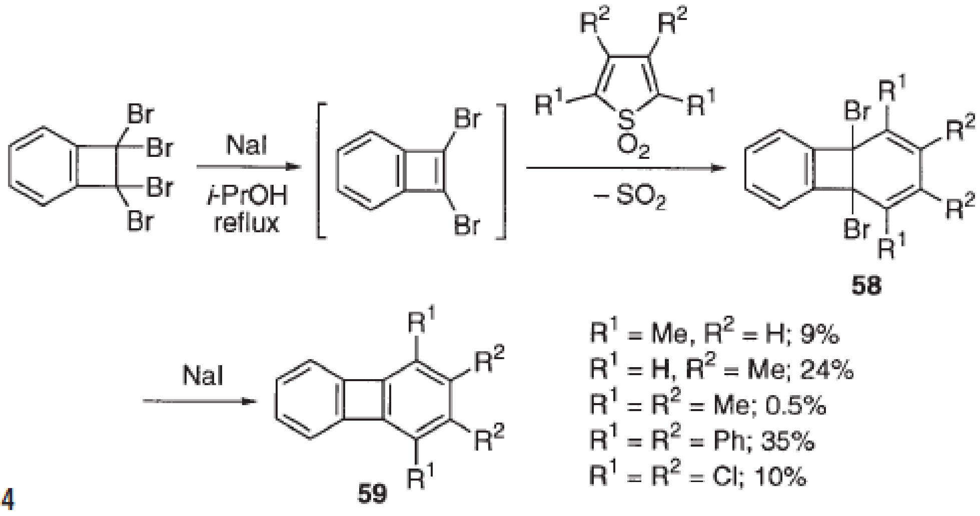
Category B: Benzene Ring-Forming Reactions by Removal of a Small Molecule from Initial Adducts



ıe 33

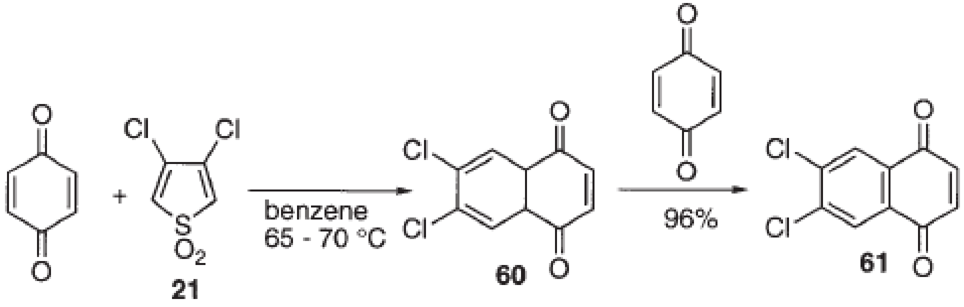
Reactivities:

Category B: Benzene Ring-Forming Reactions by Removal of a Small Molecule from Initial Adducts



R^1 = Me, R^2 = H; 9%
R^1 = H, R^2 = Me; 24%
R^1 = R^2 = Me; 0.5%
R^1 = R^2 = Ph; 35%
R^1 = R^2 = Cl; 10%

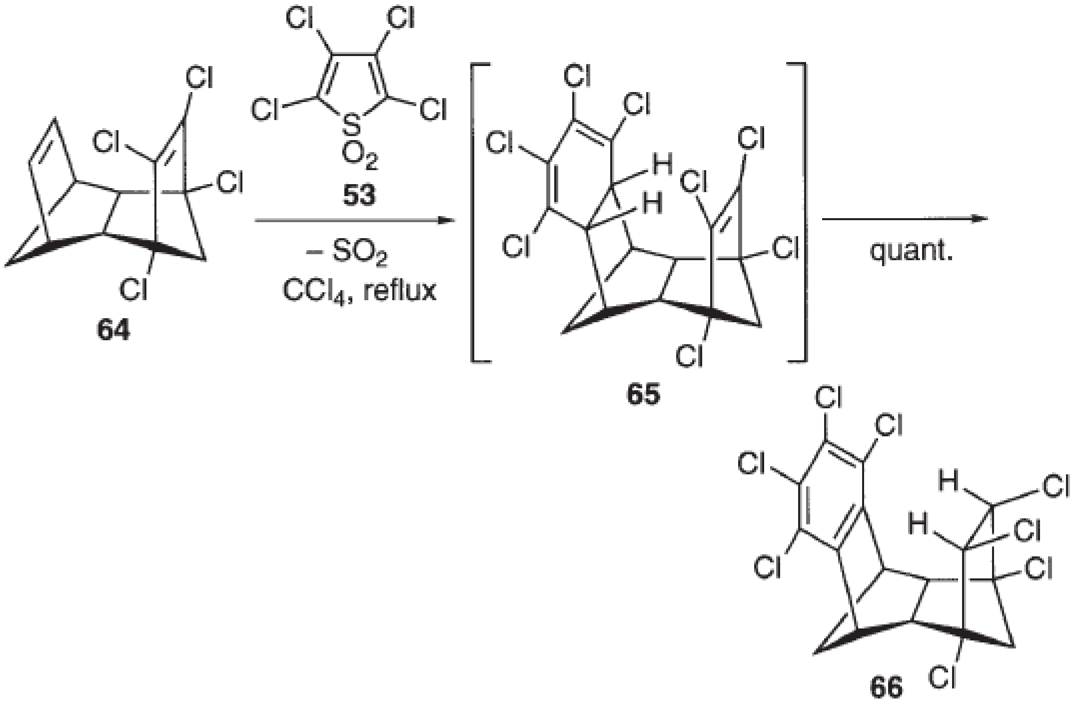
Scheme 34



Scheme 35

Barton. JW, Shepherd. MK,Willis. RJ. *J Chem Soc Perkin Trans* (**1986**) 1 967

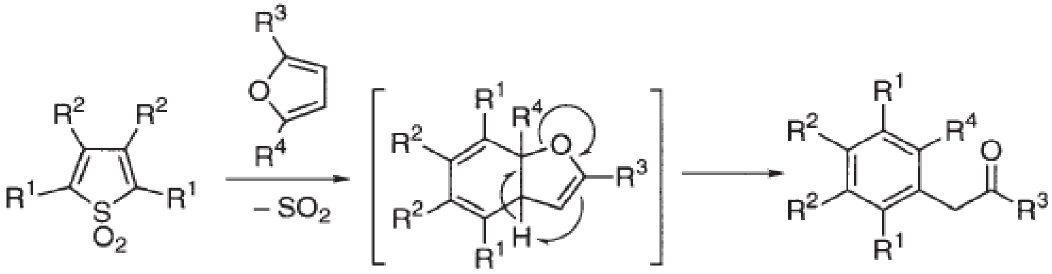
Reactivities: *Category B: Benzene Ring-Forming Reactions by Removal of a Small Molecule from Initial Adducts*



Fessner W-D, Sedelmeier G, Spurr PR, Rihs G, Prinzbach H. *J Am Chem Soc* (**1987**)109:4626

Reactivities:

Category C: Benzene Ring-Forming Reactions by Ring Opening of Initial Adducts



69

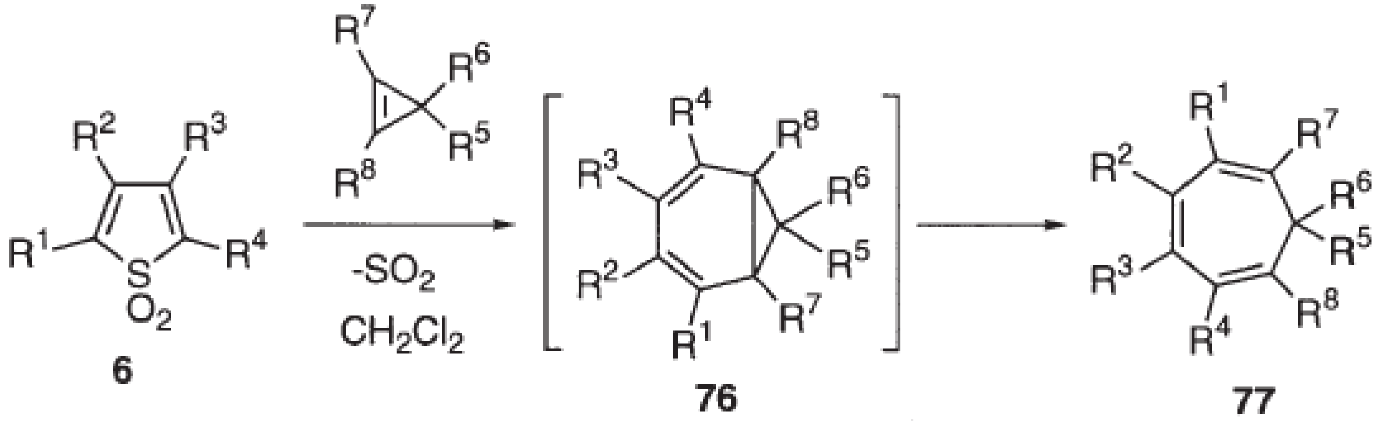
70

hexane, 65 °C, 30 min	$R^1 = R^2 = Cl$, $R^3 = Me$, $R^4 = H$: 92%
hexane, 65 °C, 30 min	$R^1 = R^2 = Cl$, $R^3 = Bu$, $R^4 = H$: 93%
93 °C, 30 min	$R^1 = R^2 = Cl$, $R^3 = R^4 = Me$: 90%
93 °C, 30 min	$R^1 = R^2 = Br$, $R^3 = R^4 = Me$: 90%
93 °C, 30 min	$R^1 = Cl$, $R^2 = H$, $R^3 = R^4 = Me$: 77%
$ClCH_2CH_2Cl$, 83 °C, 1 h	$R^1 = R^2 = Cl$, $R^3 = CH_2OAc$, $R^4 = H$: 74%
$ClCH_2CH_2Cl$, 83 °C, 1 h	$R^1 = R^2 = Cl$, $R^3 = CH_2NHAc$, $R^4 = H$: 74%
CH_2Cl_2, 30 °C	$R^1 = R^2 = Cl$, $R^3 = OMe$, $R^4 = H$: 77%
100 °C, 22 h	$R^1 = R^2 = Cl$, $R^3 = CO_2Me$, $R^4 = H$: 62% (enol form)
125 °C, 1 h	$R^1 = R^2 = Cl$, $R^3 = COMe$, $R^4 = H$: 37% (enol form)

Raasch,MS. *J Org Chem* (**1980**) 45, 867

Nakayama J,Yamaoka S,Nakanishi T,Hoshino M .*J Am Chem Soc* .(**1988**) 110:6598

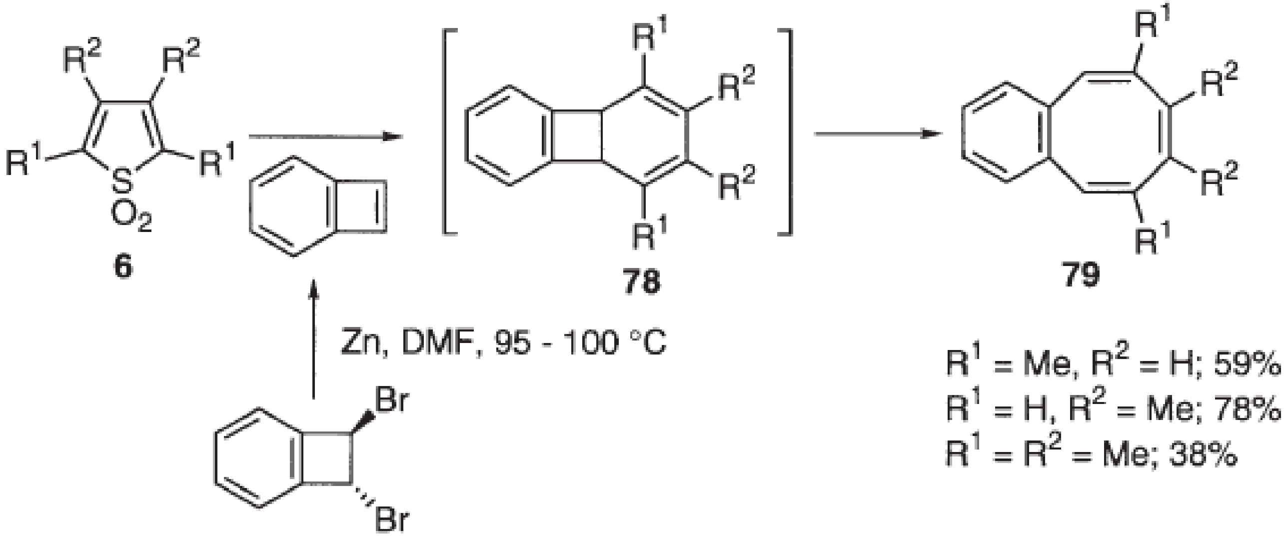
Reactivities: Category D: Seven- and Eight-Membered Ring-Forming Reactions



Takeuchi K,Yokomichi Y,Kurosaki T, Kimura Y, Okamoto K *Tetrahedron* (**1979**) 35:949

Reactivities:

Category D: Seven- and Eight-Membered Ring-Forming Reactions

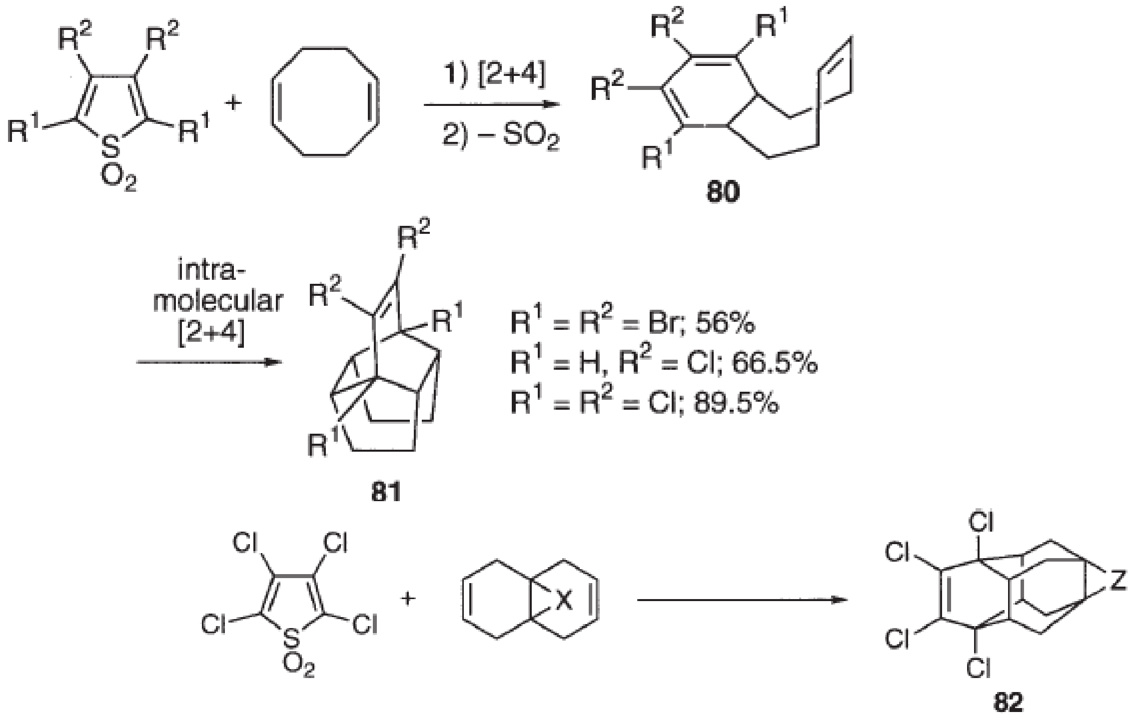


Zn, DMF, 95 - 100 °C

R^1 = Me, R^2 = H; 59%
R^1 = H, R^2 = Me; 78%
R^1 = R^2 = Me; 38%

Barton JW, Lee DC, Shepherd MK (1985) J Chem Soc Perkin Trans 1 1407

Reactivities: *Category E: [4+2] Cycloaddition Followed by Intramolecular [4+2] Cycloaddition*



80

81

$R^1 = R^2 = Br$; 56%
$R^1 = H, R^2 = Cl$; 66.5%
$R^1 = R^2 = Cl$; 89.5%

82

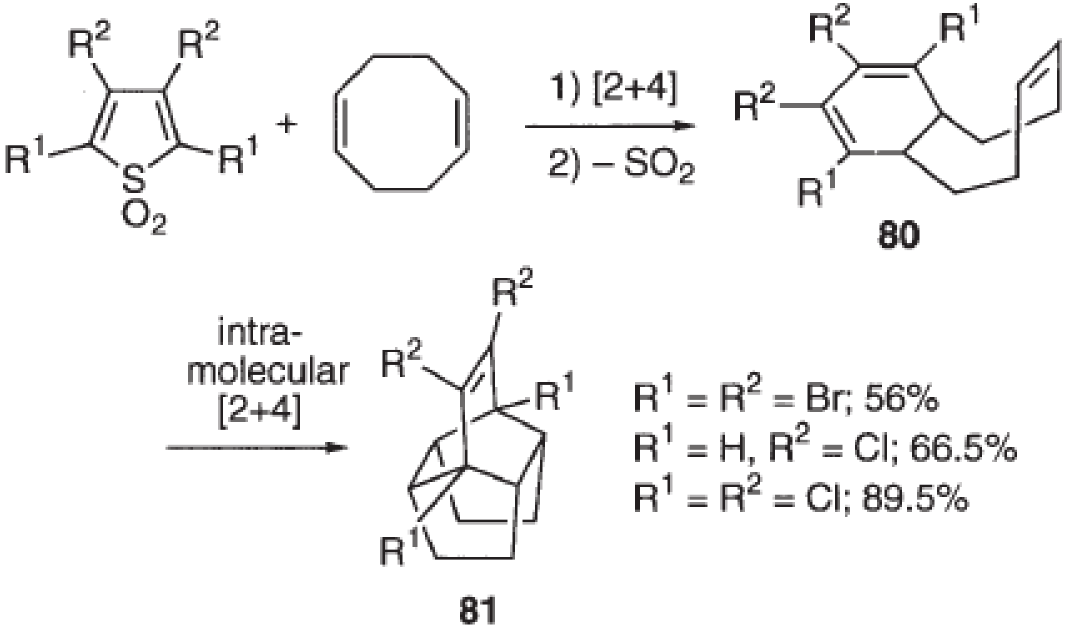
X = O	2,6-di-*t*-butyl-4-methylphenol, $NaHCO_3$, CCl_4, reflux	
X = CCl_2	neat, 120 °C	33%
X = NHCO	1,2-dichloroethane, reflux	66%
X = CO_2CO	toluene, reflux	70%
X = CH_2OCH_2	toluene, reflux	40%
X = $OC(CH_3)O$	K_2CO_3, toluene, reflux	41%

eme 48

173. Barton JW, Lee DC, Shepherd MK (1985) J Chem Soc Perkin Trans 1 1407

Reactivities:

Category E: [4+2] Cycloaddition Followed by Intramolecular [4+2] Cycloaddition

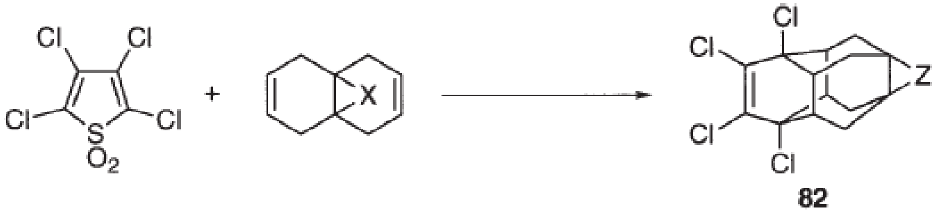


$R^1 = R^2 = Br$; 56%
$R^1 = H$, $R^2 = Cl$; 66.5%
$R^1 = R^2 = Cl$; 89.5%

173. Barton JW, Lee DC, Shepherd MK (1985) J Chem Soc Perkin Trans 1 1407

Reactivities: Category E: [4+2] Cycloaddition Followed by Intramolecular [4+2] Cycloaddition

The reaction was applied to the preparation of structurally interesting cage compounds



82

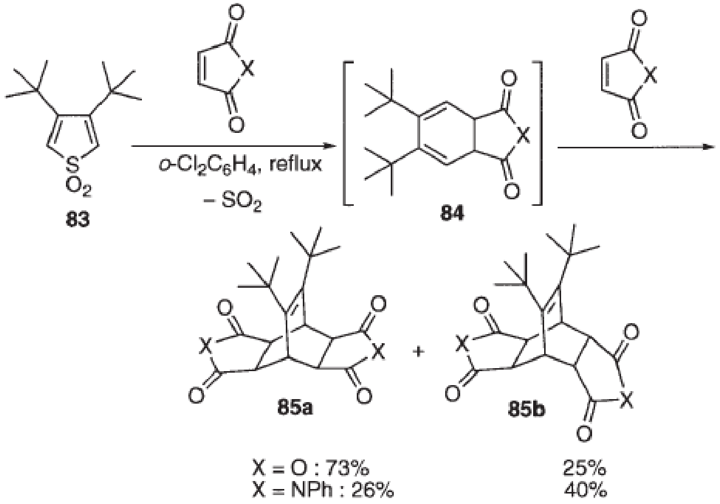
eme 48

X	Conditions	Yield
X = O	2,6-di-*t*-butyl-4-methylphenol, $NaHCO_3$, CCl_4, reflux	
X = CCl_2	neat, 120 °C	33%
X = NHCO	1,2-dichloroethane, reflux	66%
X = CO_2CO	toluene, reflux	70%
X = CH_2OCH_2	toluene, reflux	40%
X = $OC(CH_3)O$	K_2CO_3, toluene, reflux	41%

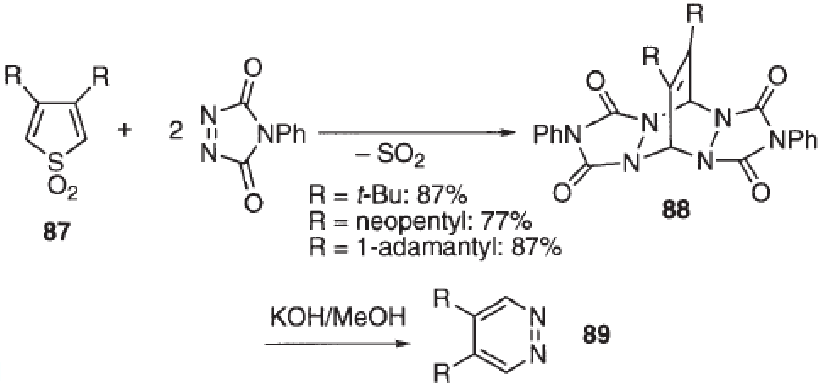
Ban T, Nagai K, Miyamoto Y, Harano K, Yasuda M, Kanematsu K *J Org Chem* (**1982**)47:110

Reactivities:

Category F: Bis-Adduct Formation



Nakayama J,Hirashima A. *J Am Chem Soc* (**1990**) 112:7648

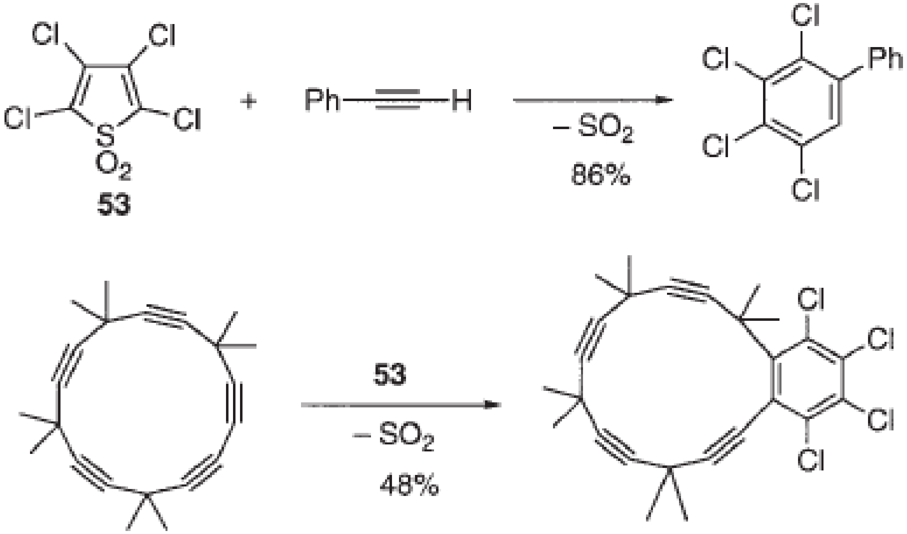


174. Nakayama J, Hirashima A (1989) Heterocycles 29:1241

Reactivities:

[4+2] Cycloaddition with Alkynic Dienophiles

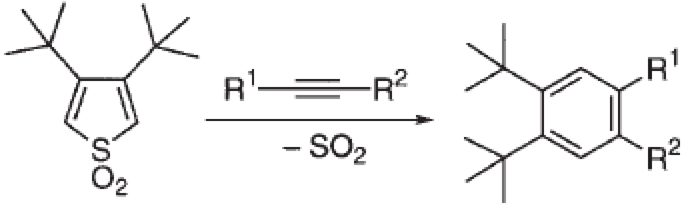
[4+2] Cycloaddition of thiophene 1,1-dioxides with alkynic dienophiles leads to the formation of benzene derivatives with elimination of sulfur dioxide



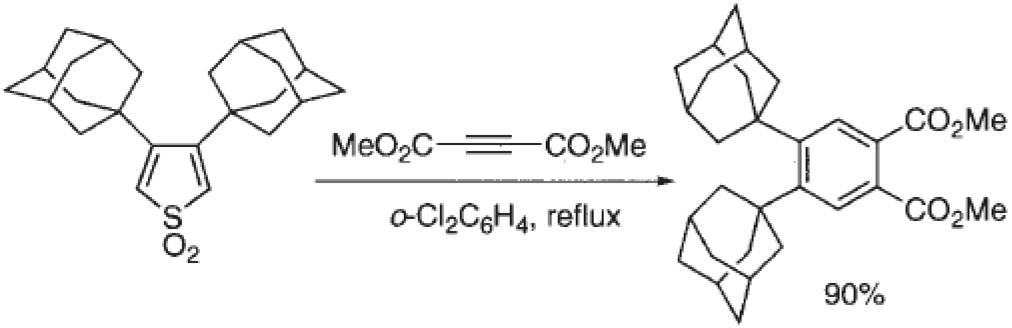
Scott LT, Cooney MJ, Otte C, Puls C, Haumann T, Boese R, Carroll PJ, Smith AB III, de Meijere A (1994) J Am Chem Soc 116:10275

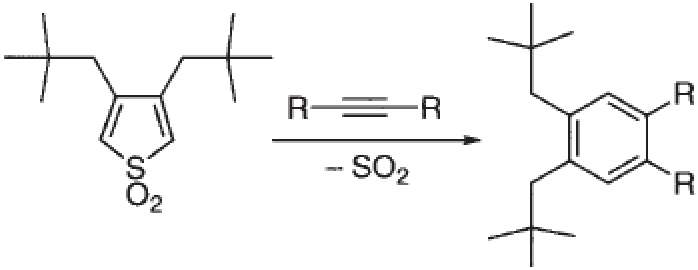
Reactivities:

[4+2] Cycloaddition with Alkynic Dienophiles



R^1 = H, R^2 = Ph; 92%
R^1 = H, R^2 = C_4H_9; 32%
R^1 = H, R^2 = COMe; 84%
R^1 = H, R^2 = CO_2Me; 72%
R^1 = R^2 = CO_2Me; quant.
R^1 = R^2 = Ph; 27%
R^1 = SPh, R^2 = NEt_2; 34%
R^1, R^2 = $-(CH_2)_6$-; 92%

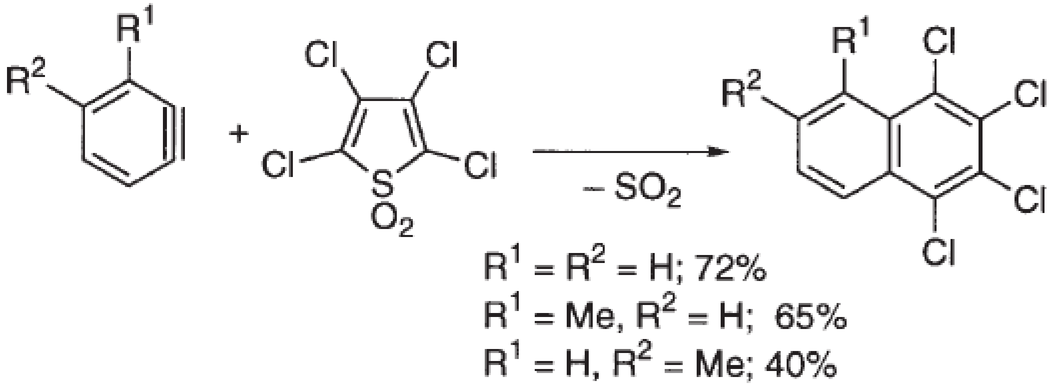


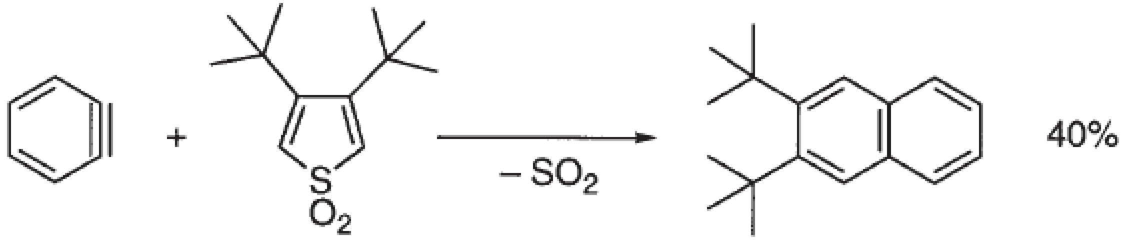


R = CO_2Me; 93%
R = Ph; 25%
R, R = $-(CH_2)_6$-; 98%

Nakayama J, Yamaoka S, Nakanishi T, Hoshino M (1988) J Am Chem Soc 110:6598

Reactivities: *[4+2] Cycloaddition with Alkynic Dienophiles*

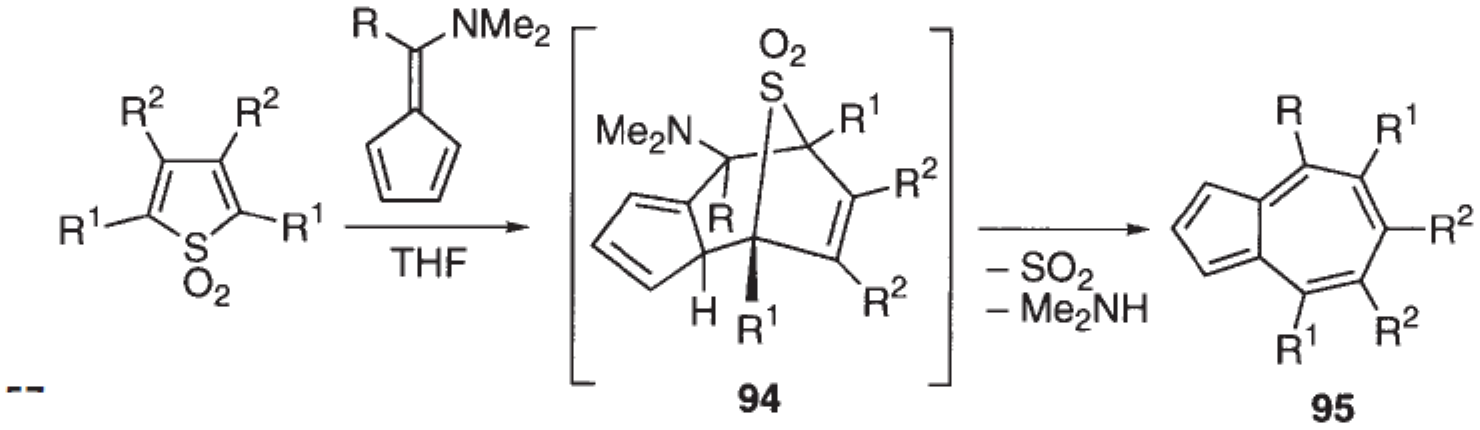




34. Nakayama J, Kuroda M, Hoshino M (1986) Heterocycles 24:1233

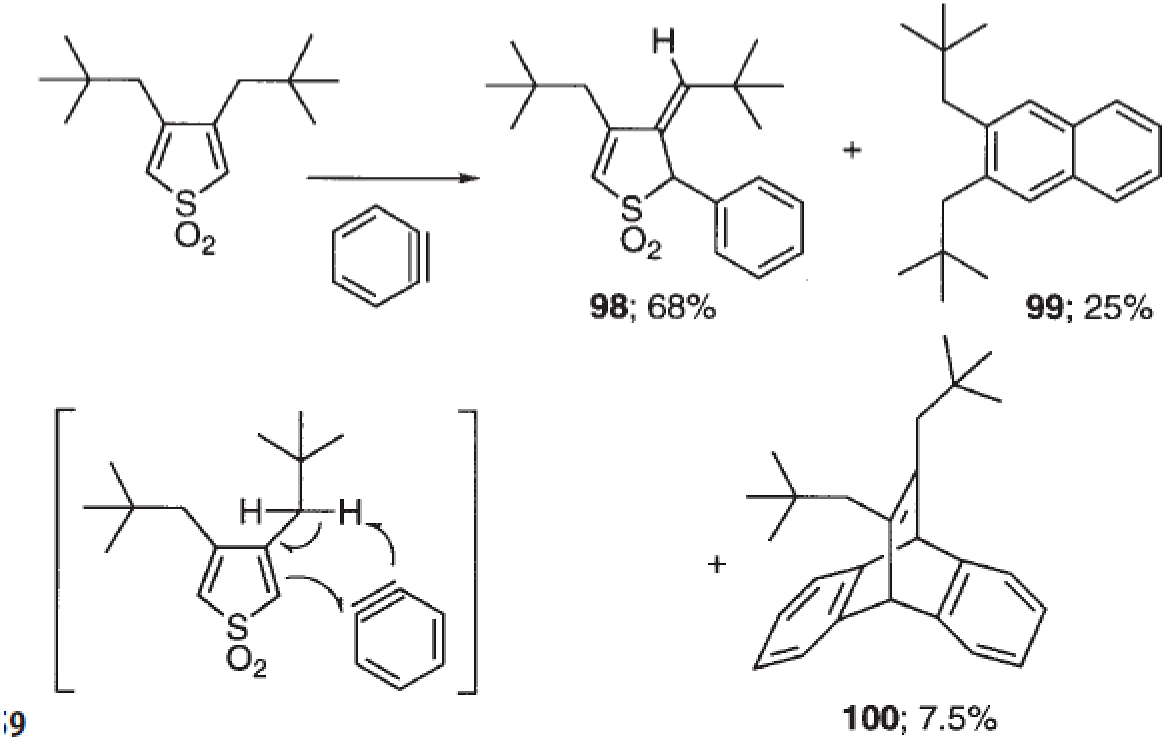
Nakayama J, Yamaoka S, Nakanishi T, Hoshino M (1988) J Am Chem Soc 110:6598

Reactivities: *[4+6] Cycloaddition*



Becker J,Wentrup C,Katz E, Zeller K-P. *J Am Chem Soc* (**1980**) 102:5110

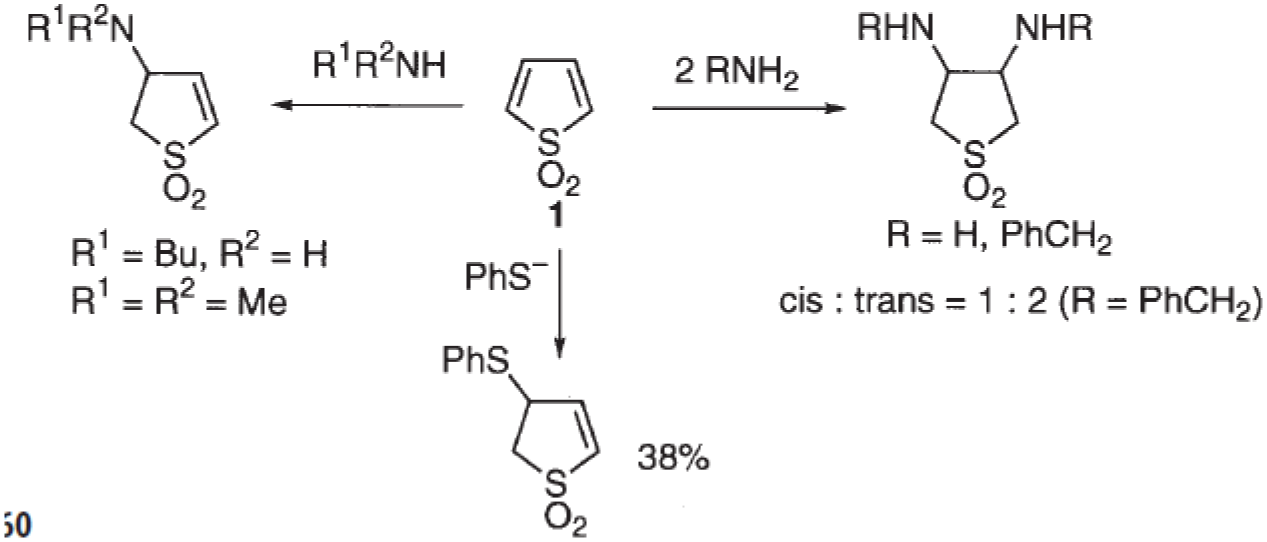
Reactivities: *Ene Reaction*



Nakayama J,Yoshimura K Tetrahedron Lett (**1994**) 35:2709

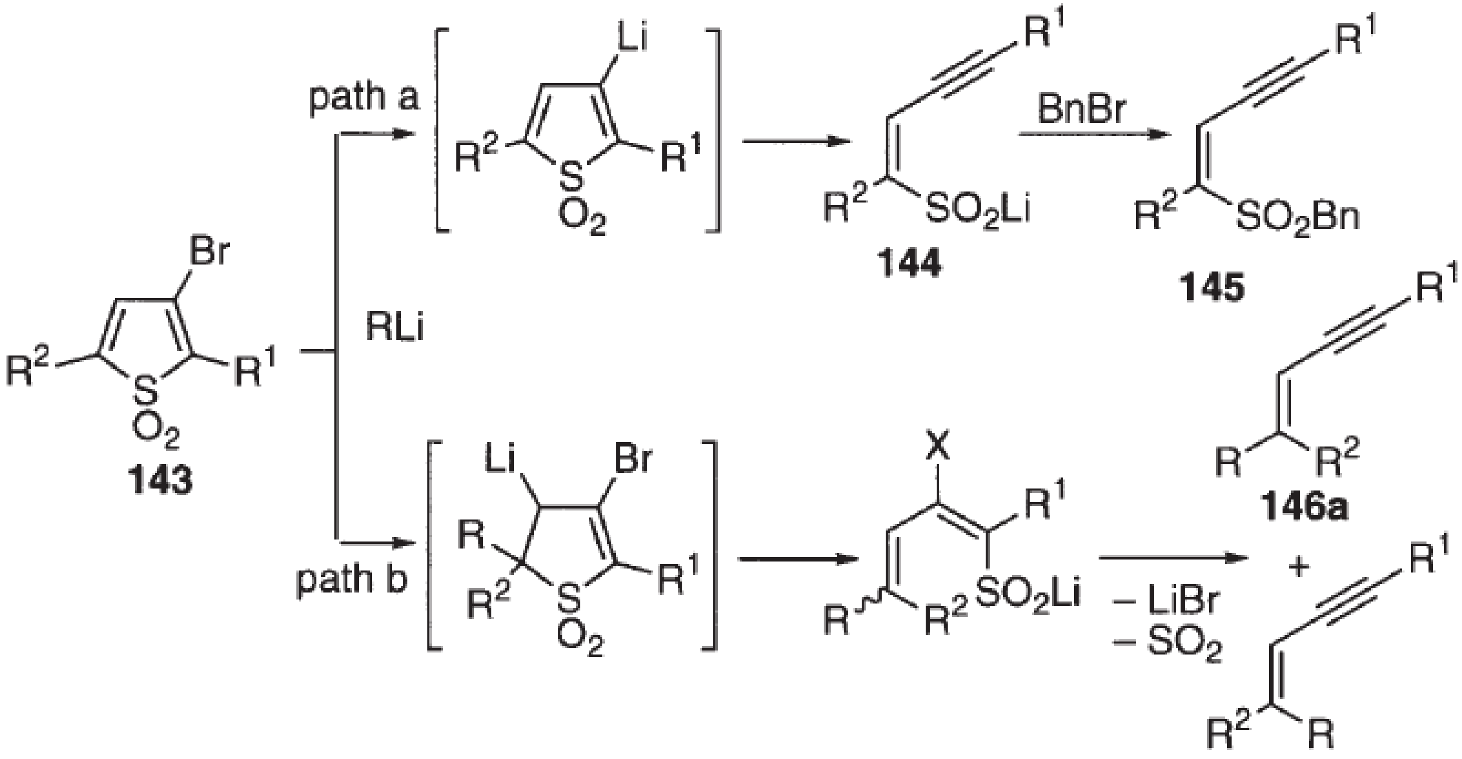
Reactivities: Nucleophilic Addition

Thiophene 1,1-dioxides are typical a,b-unsaturated sulfones and take part in a nucleophilic 1,4-addition acting as Michael acceptors



Chou T-S, Chen M-H. *Heterocycles*(**1987**) 26:2829
Bailey WJ, Cummins EW. *J Am Chem Soc* (**1954**) 76:1932
Bates HA, Smilowitz L, Lin J. *J Org Chem* (**1985**) 50:899

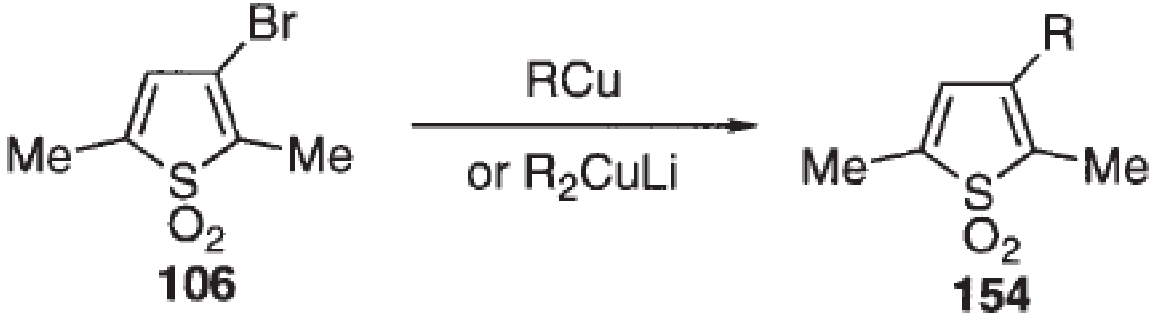
Reactivities: *ring opening reaction*



Karlsson JO,Gronowitz S,Hallberg A. *Chem Scr* (**1982**) 20:37
Karlsson JO,Gronowitz S,Hallberg A. *Acta Chem Scand* (**1982**) 36B:341

Reactivities: *ring alkylation*

Ring alkylation of thiophene 1,1-dioxides was performed in two ways



106

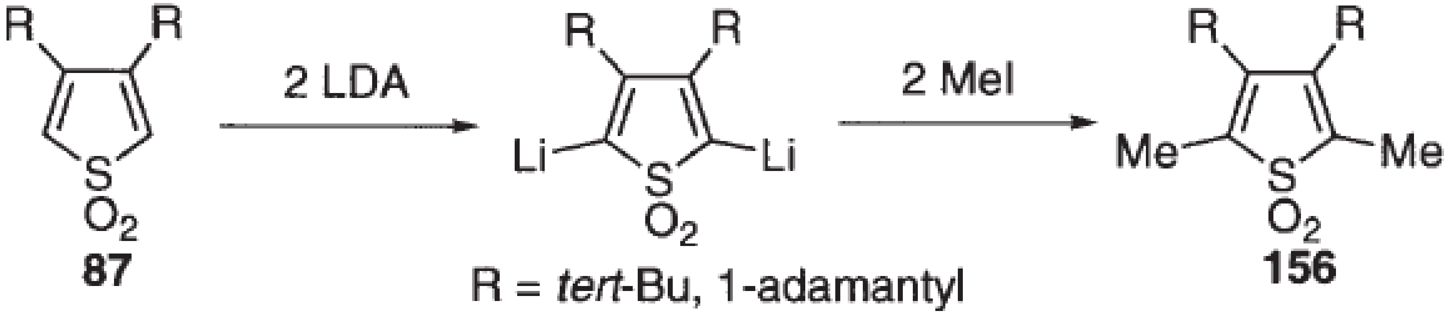
154

RCu: R = Me, 100%; R = Et, 100%; R = Bu, 100%; R = *tert*-Bu; 47%
R_2CuLi: R = Me, 78%; R = Et, 83%; R = Bu, 53%; R = *tert*-Bu; 11%

Gronowitz S, Bugarcic Z,Hörnfeldt A-B. *J Heterocycl Chem* (**1992**) 29:1077

Reactivities: *ring alkylation*

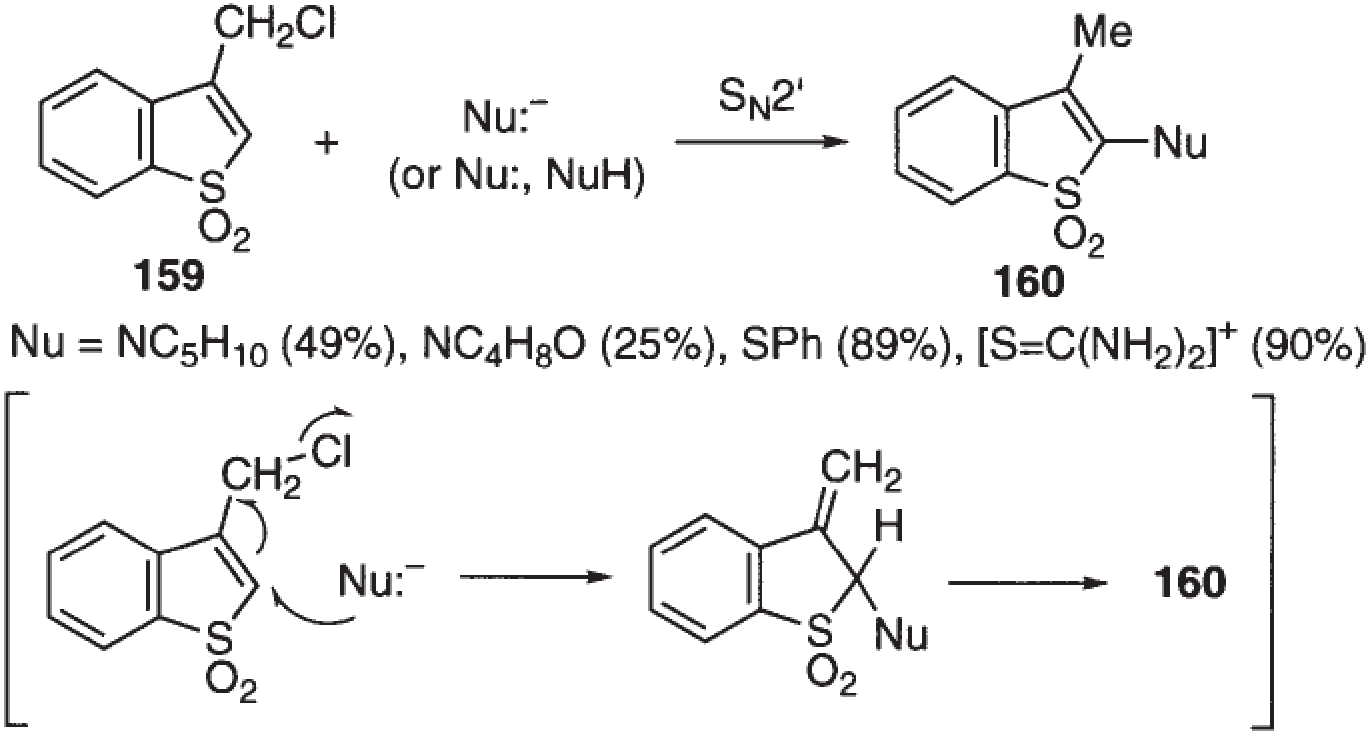
On the another hand



R = *tert*-Bu, 1-adamantyl

Kamiyama H, Nakayama J, unpublished results. See also: Kamiyama H, Hasemi R, Nakayama J. *Heteroatom Chem.* (**1993**) 4:445

Reactivities: $S_{N2`}$ *reaction*

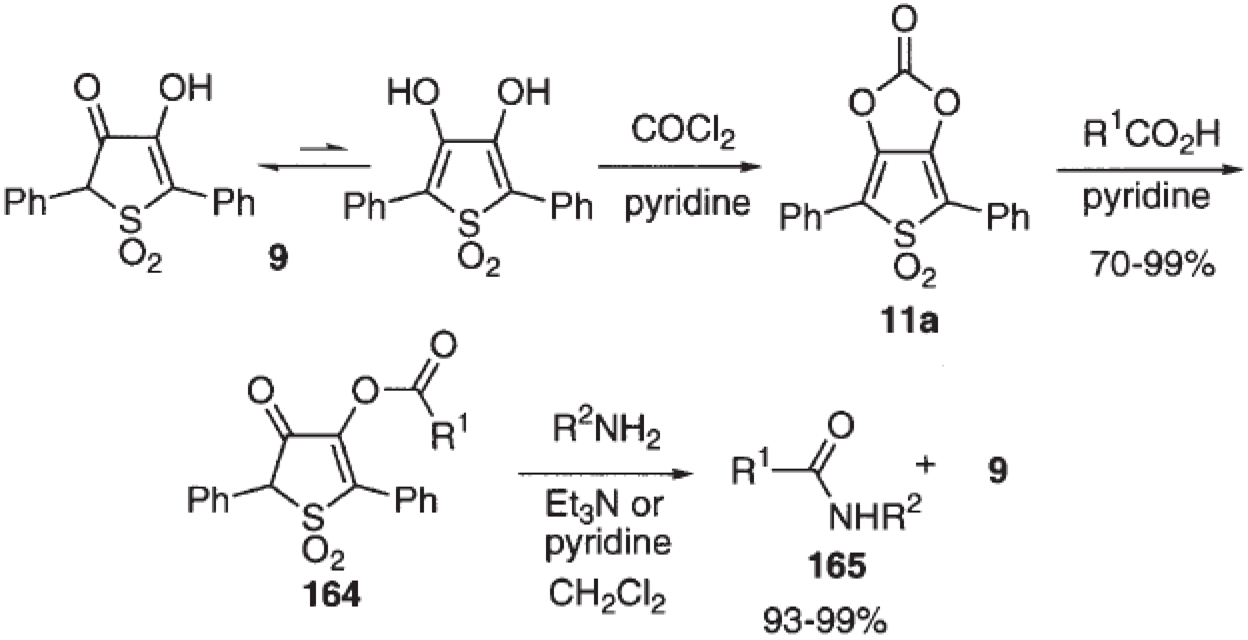


Nu = NC_5H_{10} (49%), NC_4H_8O (25%), SPh (89%), $[S{=}C(NH_2)_2]^+$ (90%)

Bordwell FG,Hemwall RW, Schexnayder DA .*J Am Chem Soc* (**1967**) 89:7144

Reactivities: *steglich reagent*

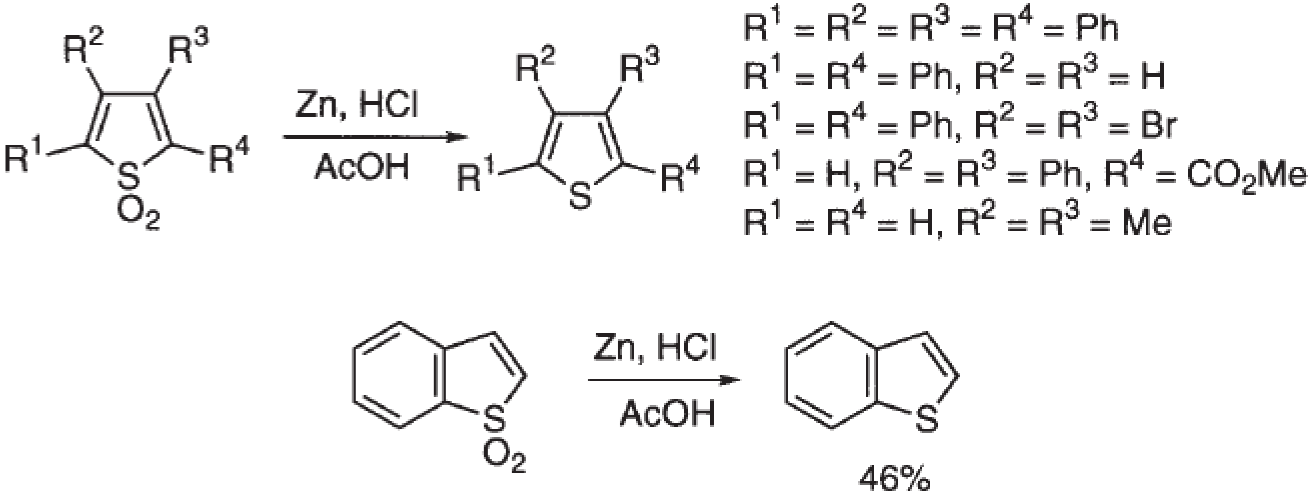
a strongly activating reagent in many condensation reactions



R^1CO = EtCO, *t*-BuCO, Cbz-Val, Cbz-Pro, Boc-Pro, Boc-Phe, Boc-Met
R^2NH_2 = Val-OMe, Val-O-*t*-Bu

Hollitzer O, Seewald A, Steglich W. *Angew Chem* (**1976**) 88:480

Reactivities: *reduction*

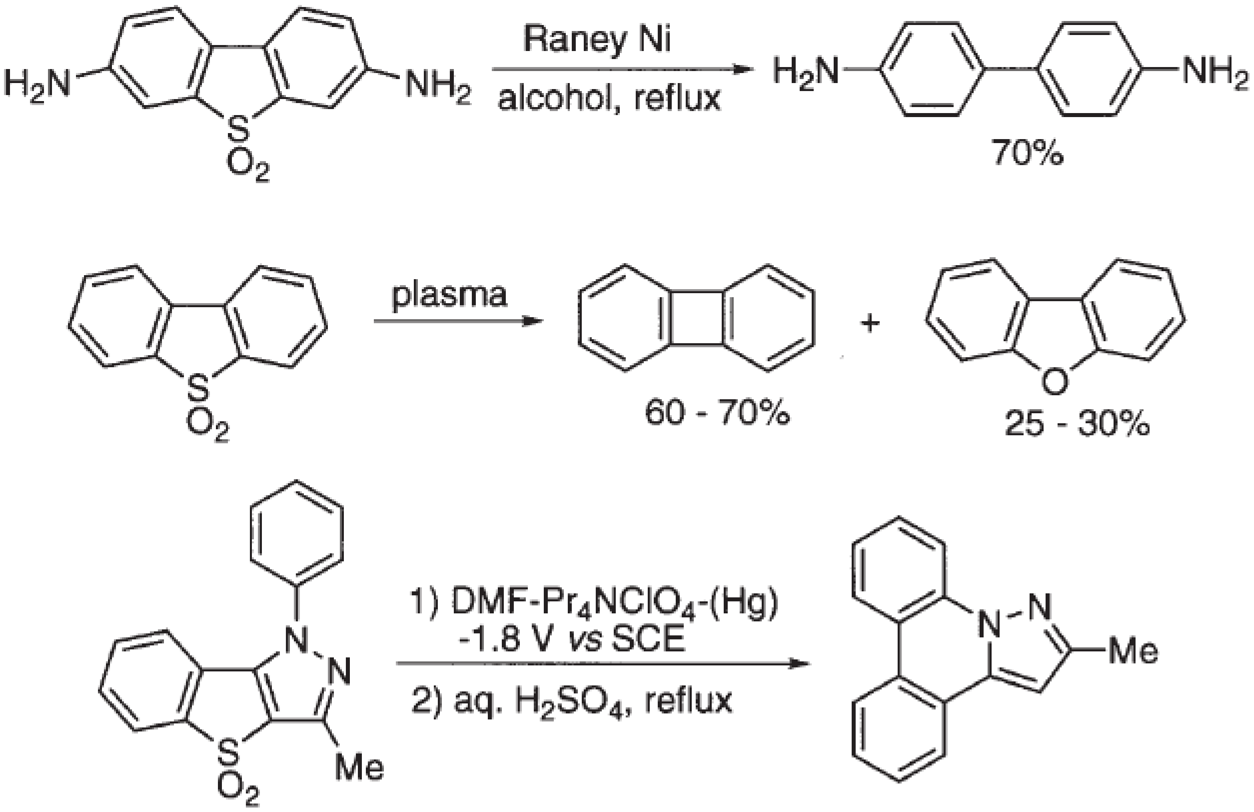


$R^1 = R^2 = R^3 = R^4 = Ph$
$R^1 = R^4 = Ph, R^2 = R^3 = H$
$R^1 = R^4 = Ph, R^2 = R^3 = Br$
$R^1 = H, R^2 = R^3 = Ph, R^4 = CO_2Me$
$R^1 = R^4 = H, R^2 = R^3 = Me$

Monocyclic thiophene 1,1-dioxides [186, 232] and benzo[*b]thiophene 1,1-* Dioxide are reduced to the corresponding thiophenes by zinc in a mixture of acetic acid and hydrochloric acid

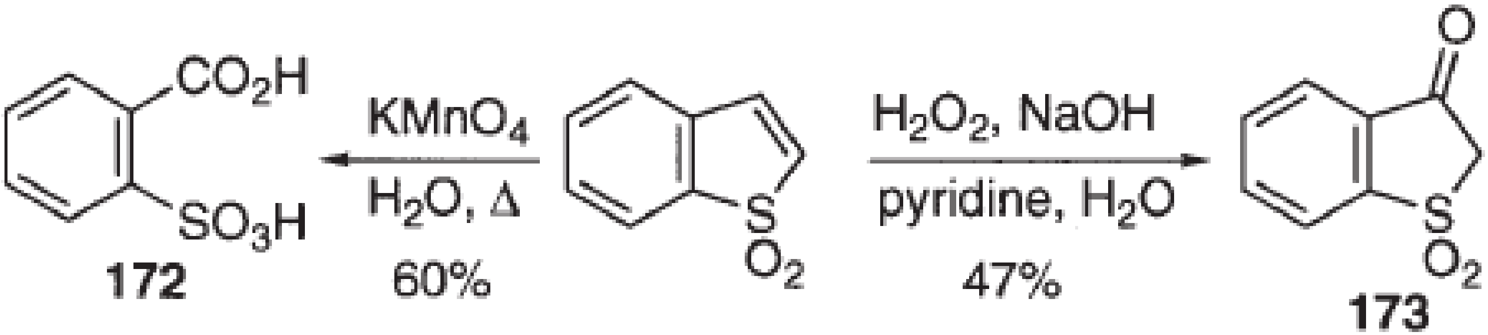
Reactivities: *reduction*

Some examples :



Grimshaw J, Trocha-Grimshaw J. *J Chem Soc Perkin Trans*. (**1979)** 1 799

Reactivities: *Oxidation*

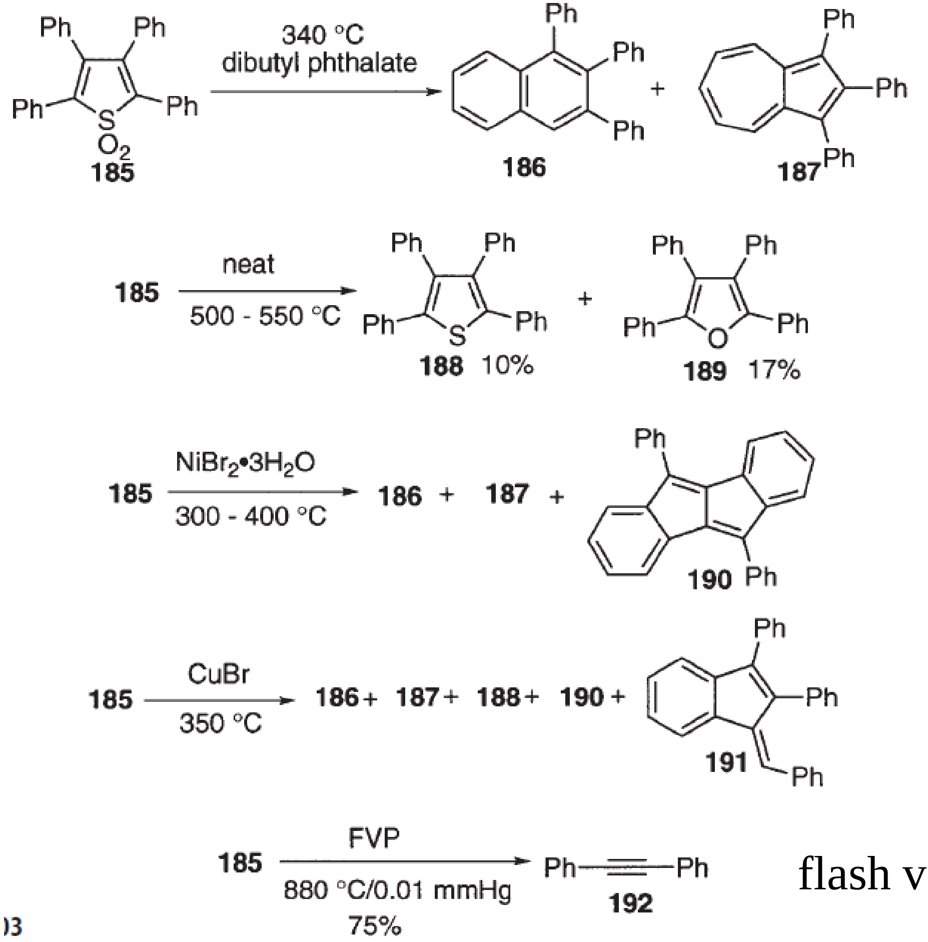


Bordwell FG,McKellin WH (1950) *J Am Chem Soc* 72:1985

Marmor S.*J Org Chem*.**(1977**) 42:2927

Reactivities: *Pyrolysis*

Pyrolysis products of thiophene 1,1-dioxides are much dependent on reaction conditions.



flash vacuum pyrolysis (FVP)

McOmie JFW, Bullimore BK .*Chem Commun* (**1965**) 63

HAPPY THANKSGIVING!