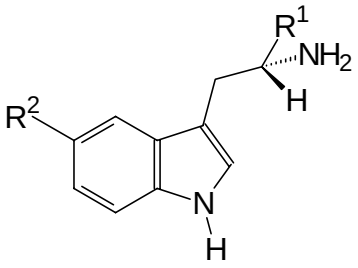
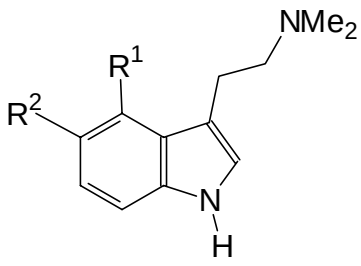
6.4 Indoles and related compounds

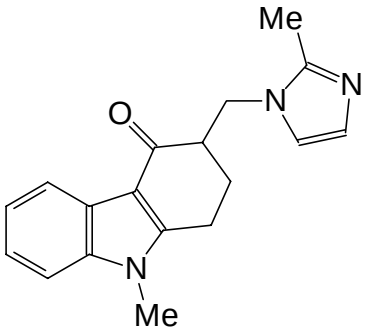
6.4.1 Introduction



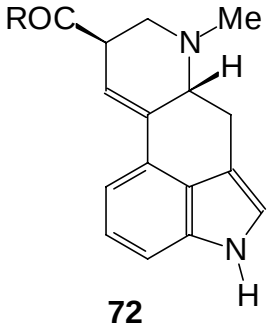
65: R = CO_2H, R = H
66: R = R = H
67: R = H, R = OH



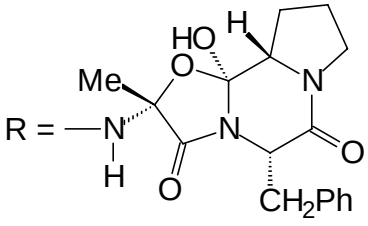
68: R = H, R = OH
69: R = OH, R = H
70: R = H, R = OMe

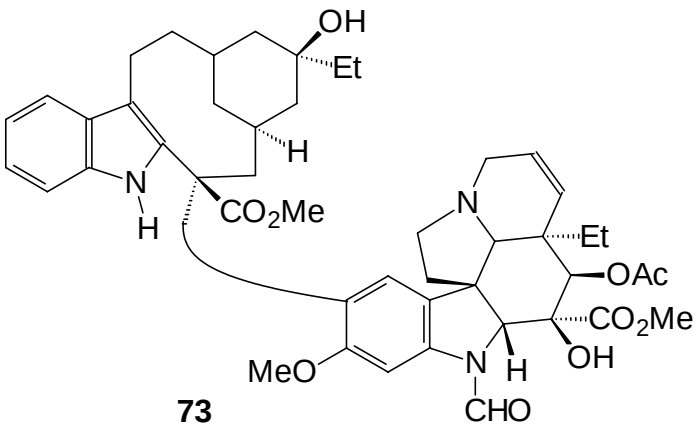


71



72





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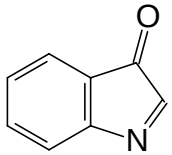
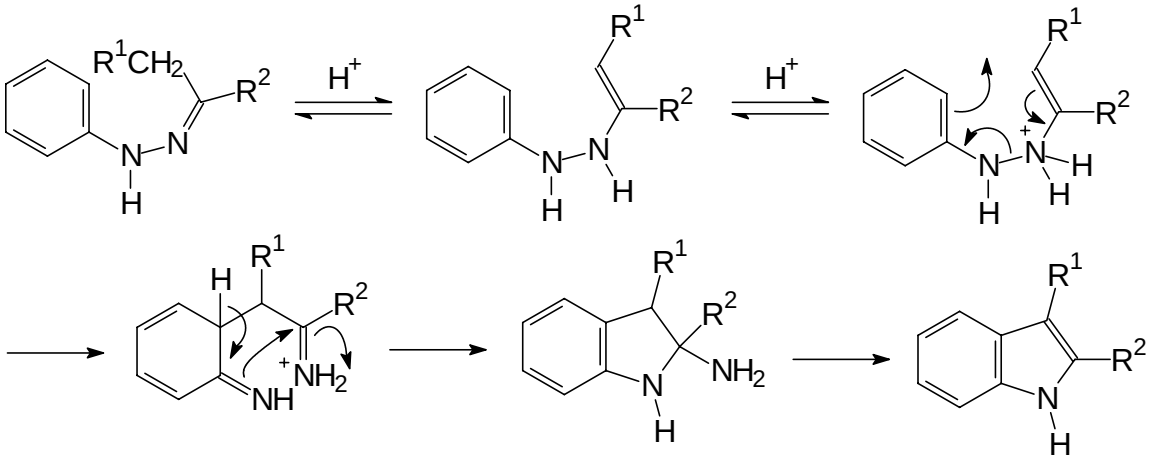


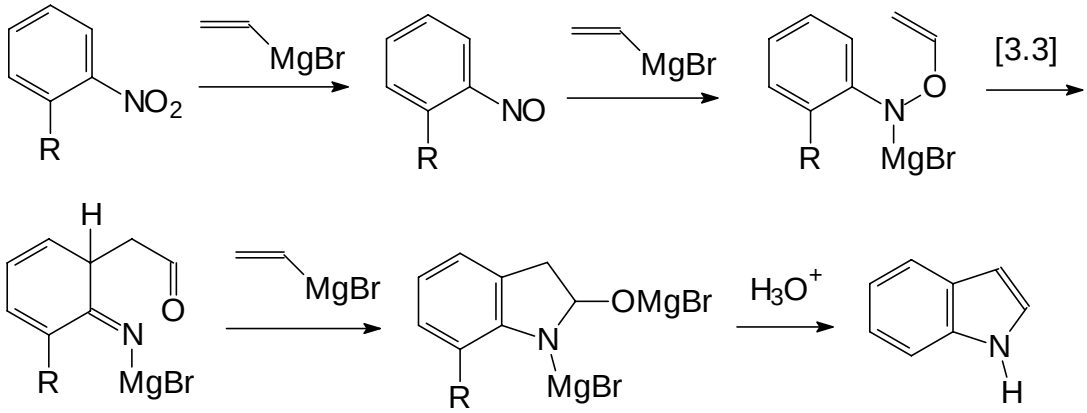
74

6.4.2 Ring synthesis

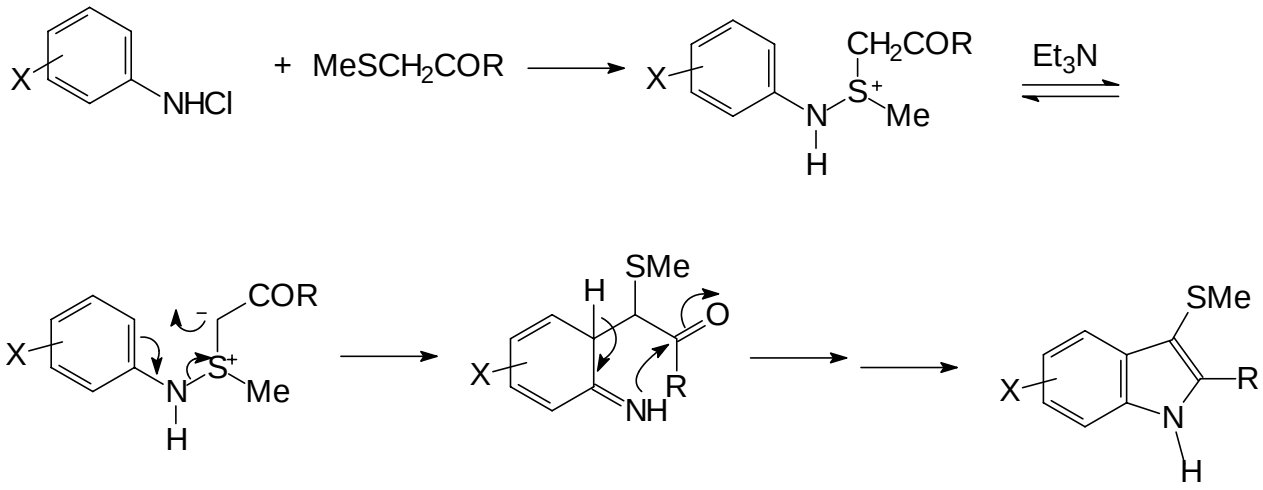
Fischer synthesis



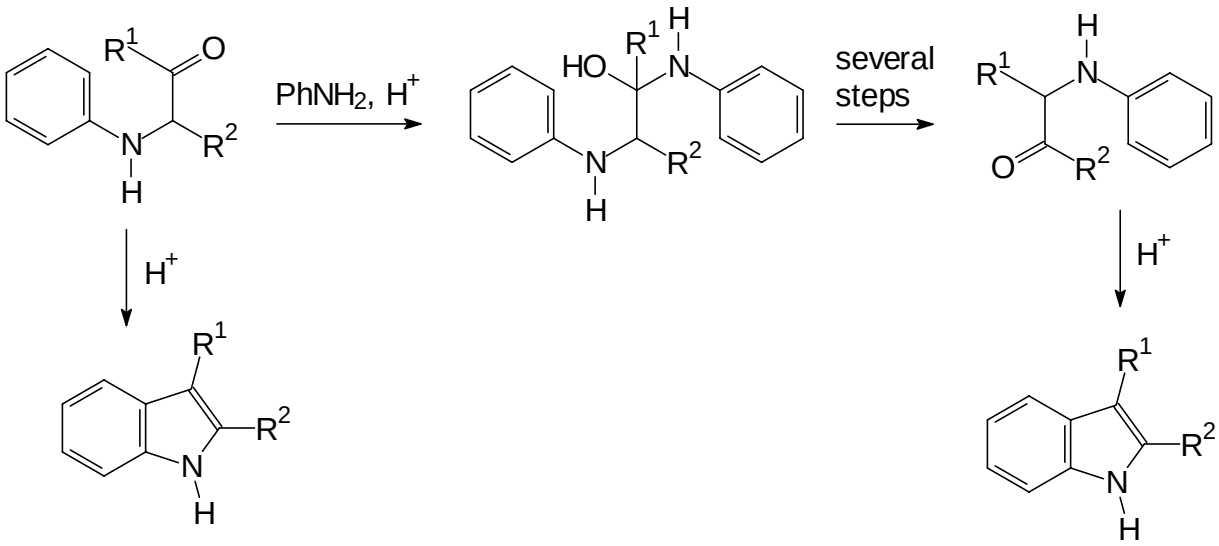
Bartoli synthesis



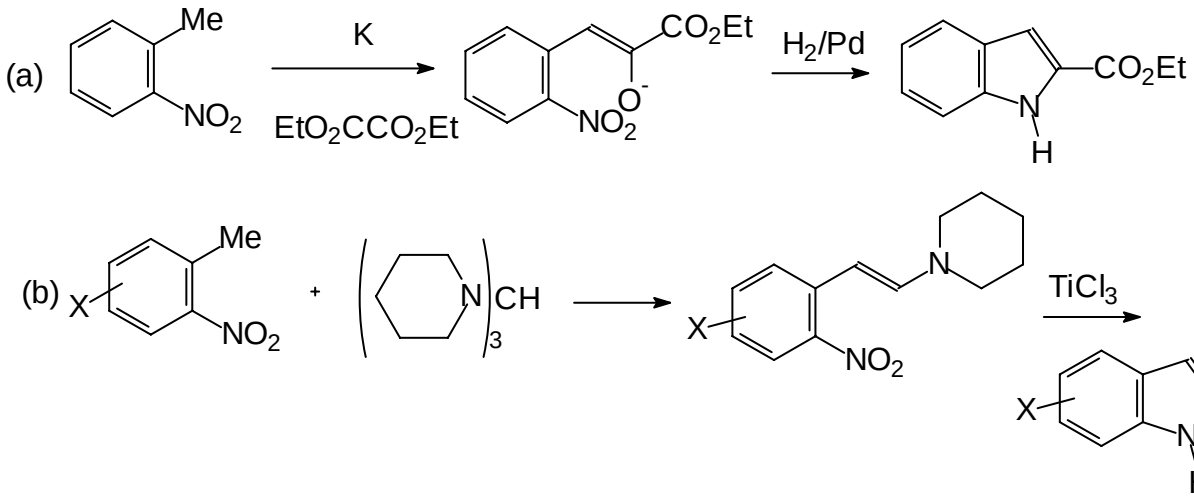
Sulfonium ylide cyclization (Gassman synthesis)



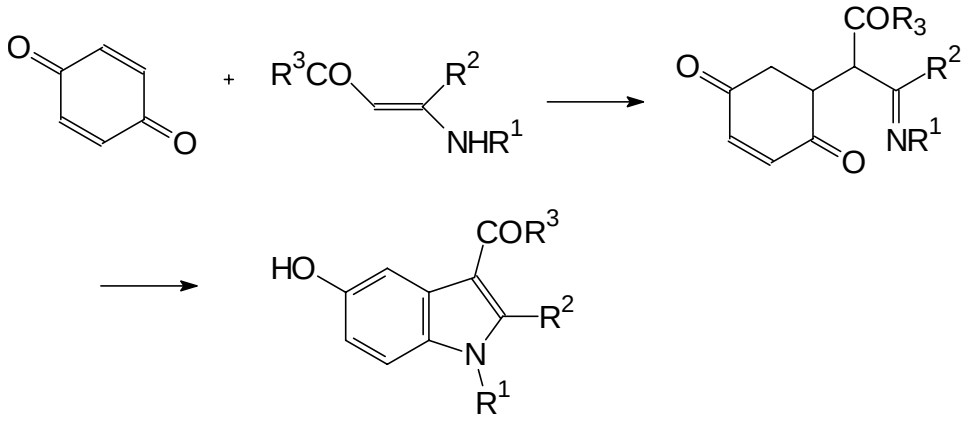
Bischler synthesis



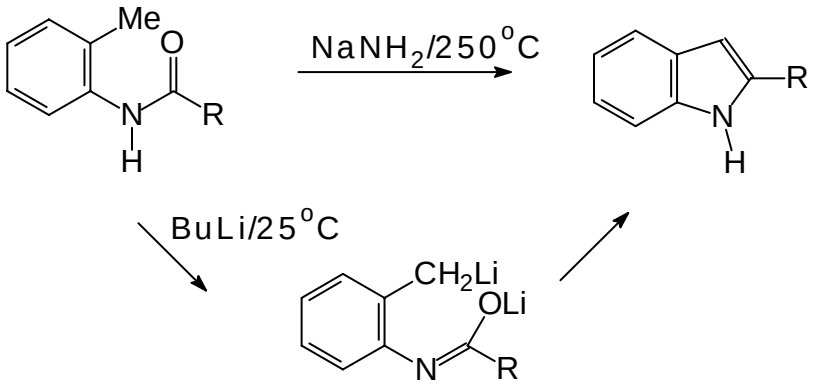
Reissert synthesis

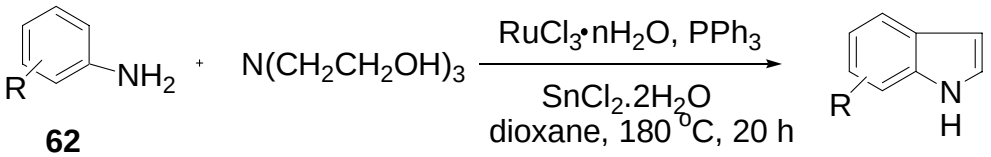


Nenitzescu synthesis



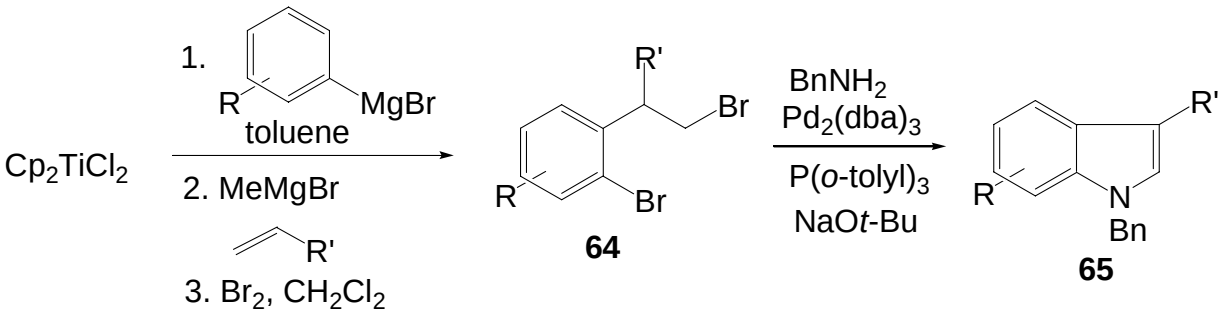
Madelung synthesis



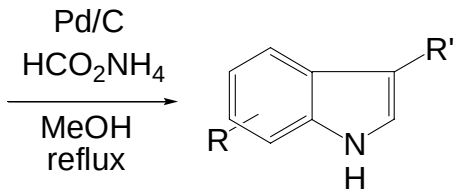


62 **63**

Chem. Commun. 1998, 995.

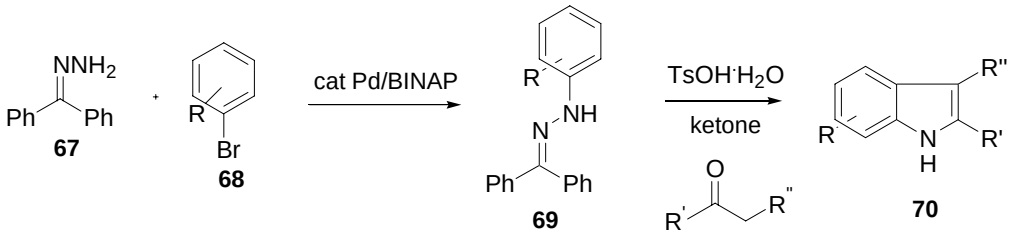


64 **65**

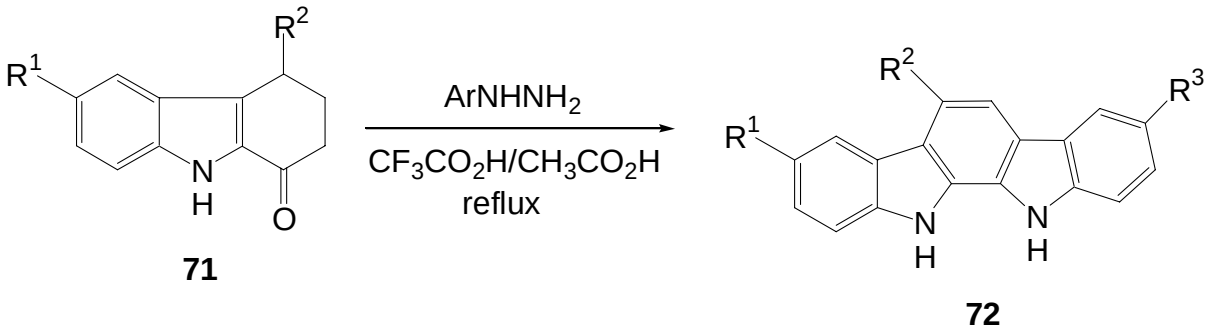


66

JACS, 1998, 3068.

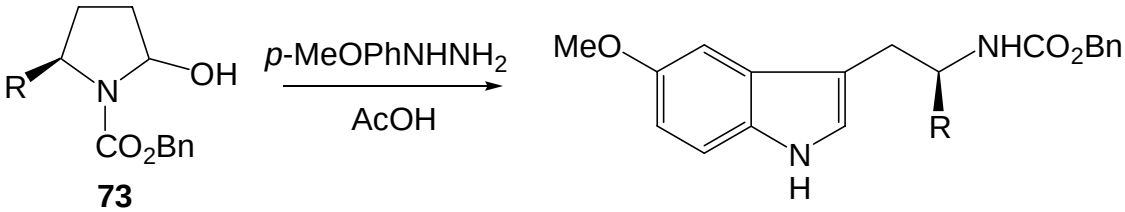


JACS, 1998, 6621.



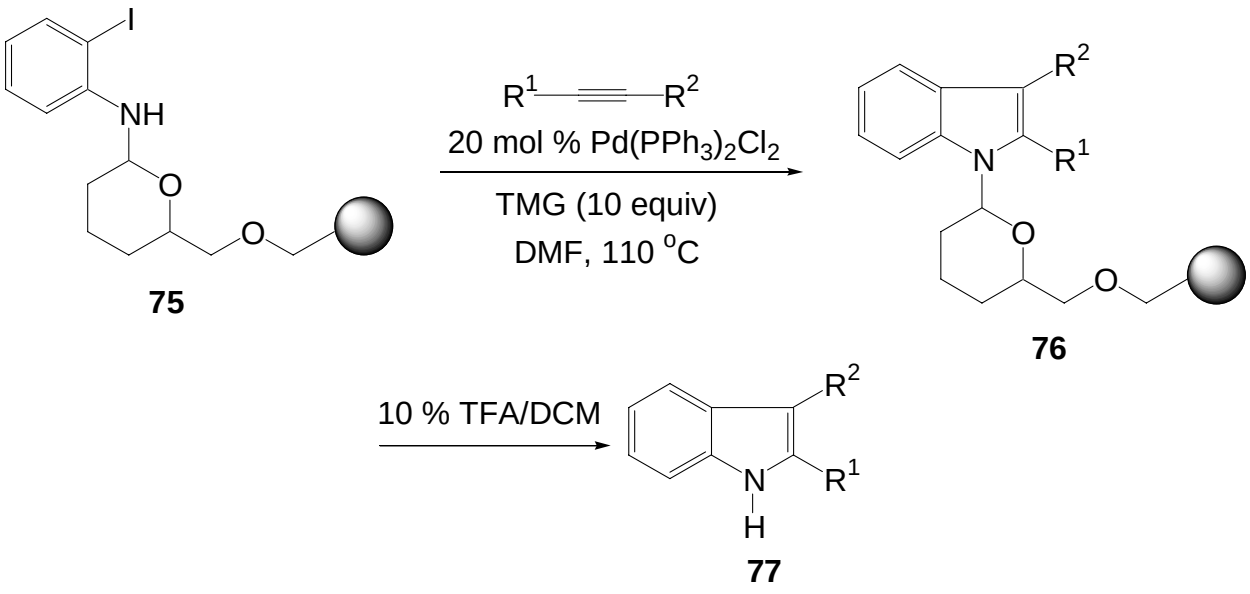
71 **72**

Synth. Commun. 1998, 1239.



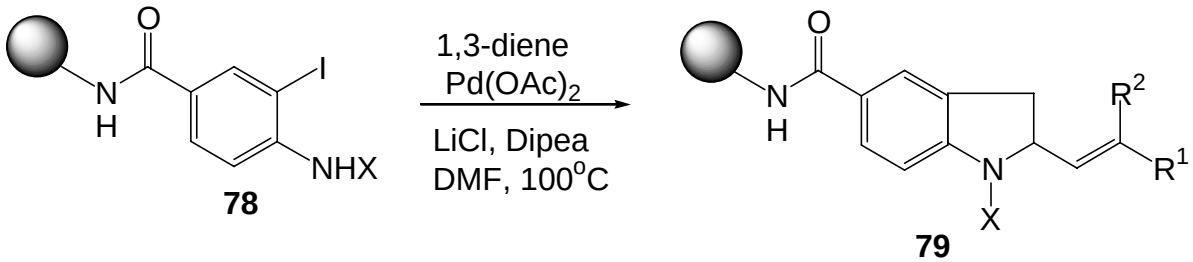
73 **74**

Synth. Commun. 1998, 3681.



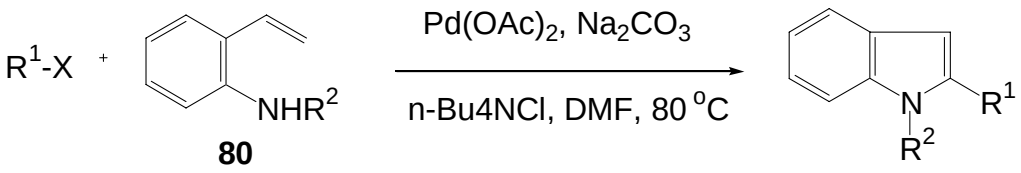
75 **76** **77**

TL, 1994, 9333.

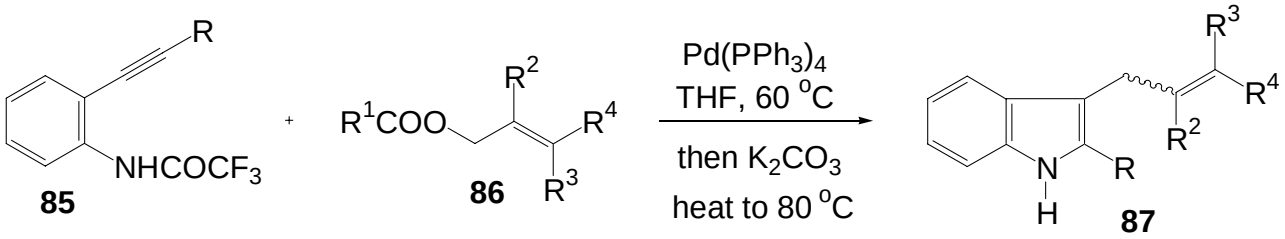


78 **79**

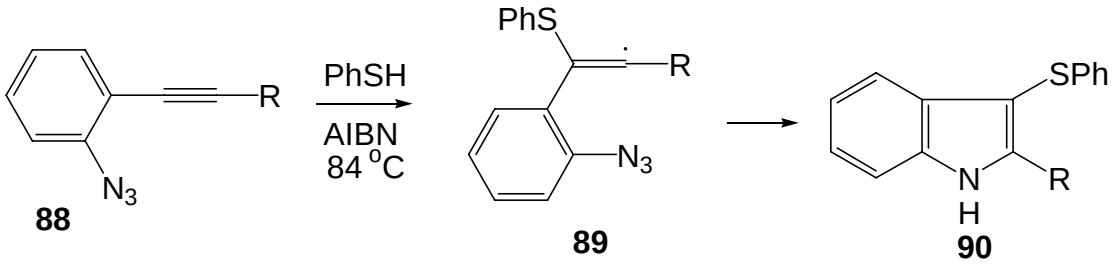
TL, 1998, 9605.



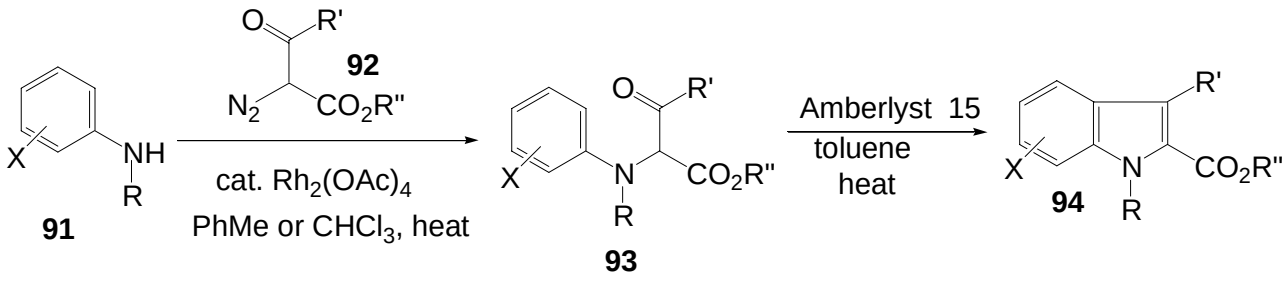
TL, 1998, 1885.



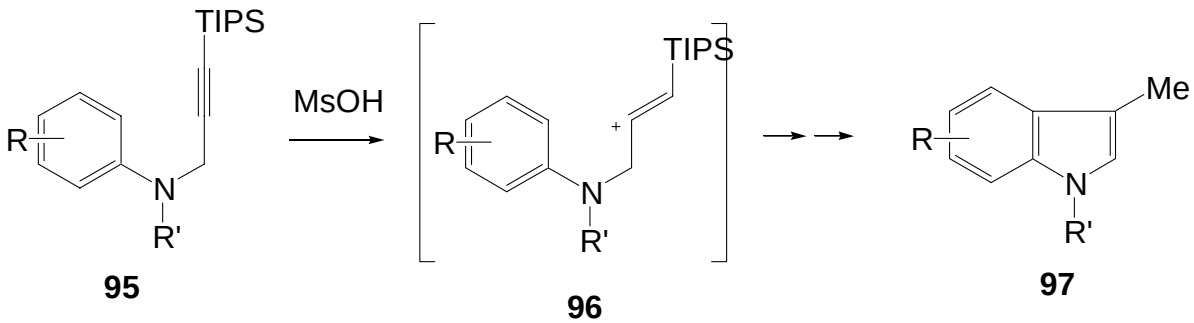
JOC, 1998, 1001.



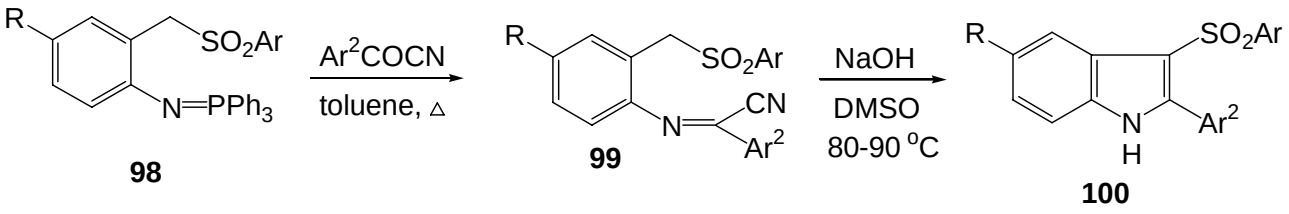
Eur. JOC, 1998, 1219.



Synlett, 1998, 135.

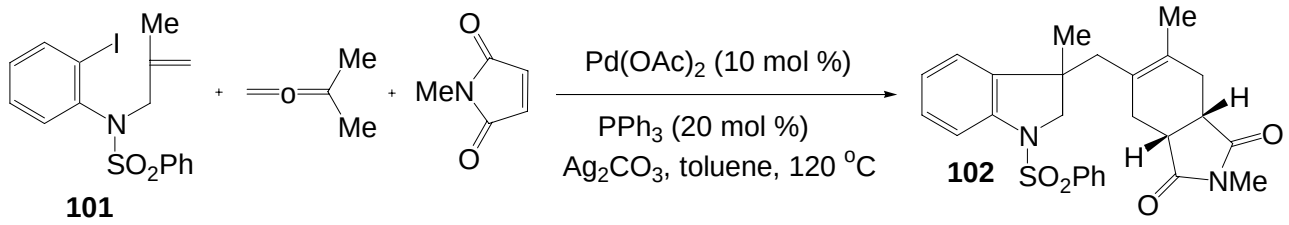


TL, 1998, 4595.



98 **99** **100**

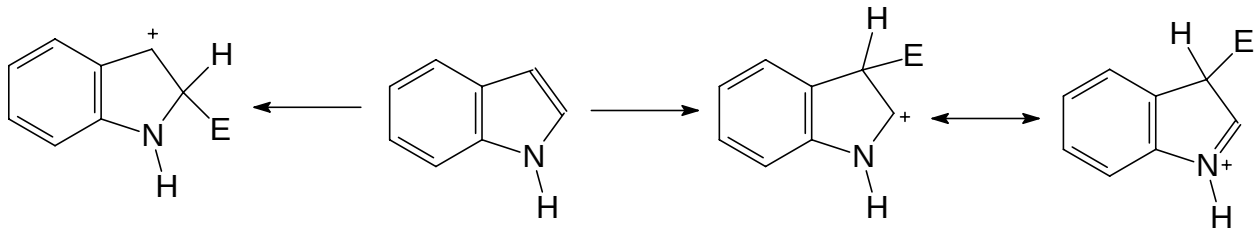
Synthesis, 1998, 986.



101 **102**

TL, 1998, 3247.

6.4.3 Reaction with electrophiles



Electrophile attack at C-2 and C-3

Table 6.4 Electrophilic substitution of indole.[a]

FG introduced	Reagents & conditions	Ref.
NO_2	$PhCONO_2$, 0°C	b
Br	NBS, CCl_4, 80°C	c
Cl	NCS, MeOH, 20°C	d
CHO	$POCl_3$, Me_2NCHO, 20-35°C	e
COMe	$(MeCO)_2O$, heat	f
$CH_2CH_2NO_2$	$CH_2=CHNO_2$, 0-20°C	g
CH_2CH_2COMe	$CH_2=CHCOMe$, AcOH, $(MeCO)_2O$, 100°C	h
$CH_2C=NOH.CO_2Et$	$BrCH_2C=NOH.CO_2Et$, Na_2CO_3, 20°C	i
CH_2NMe_2	CH_2O, Me_2NH, AcOH, 20°C	j
N=NPh	$PhN_2^+Cl^-$, KOH(aq), 0°C	k
SO_3H	SO_3-pyridine, heat	l

a. All give 3-substituted indoles.

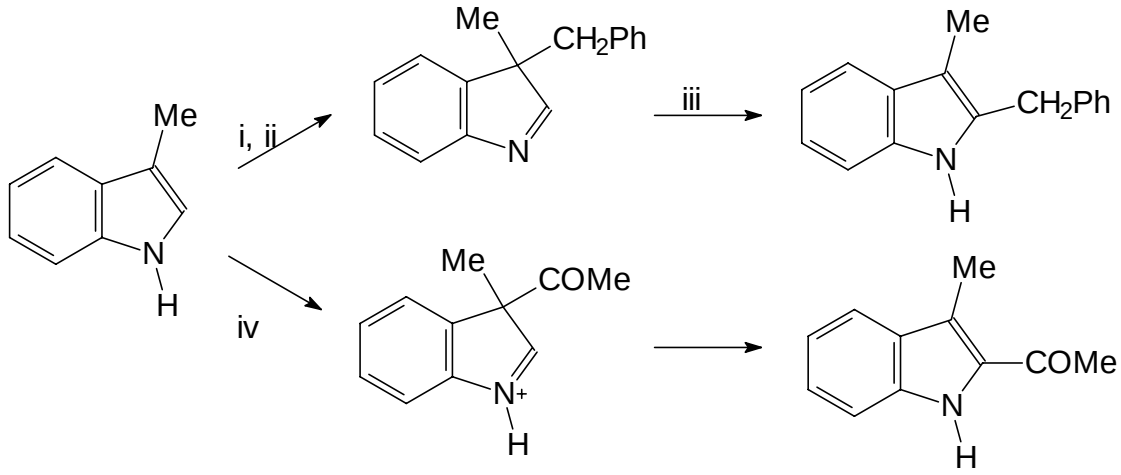
b. J. Chem. Soc. (C), **1968**, 2145.

c. Bull. Soc. Chin. Fr., **1967**, 1294.

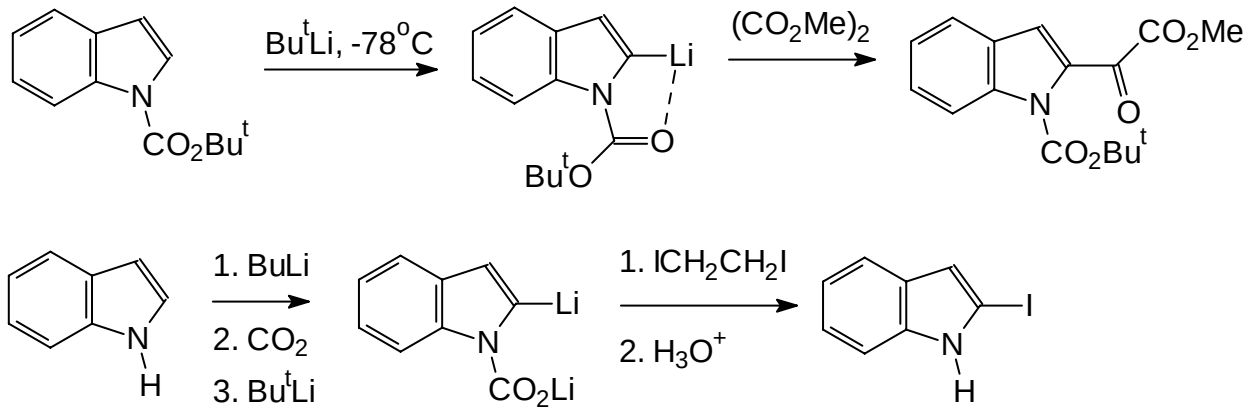
d. JOC, **1966**, 2627.

e. J. Chem. Soc. **1954**, 3842.

f. J. Chem. Soc. **1964**, 4267.
g. JOC, **1980**, 1185.
h. JACS, **1957**, 2819.
i. J. Chem. Soc. Perkins Trans. 1, **1983**, 1283.
j. Ber. **1937**, 70, 567.
k. J. Chem. Soc. Perkins Trans. 2, **1975**, 1209.
l. Tetrahedron, **1973**, 669.

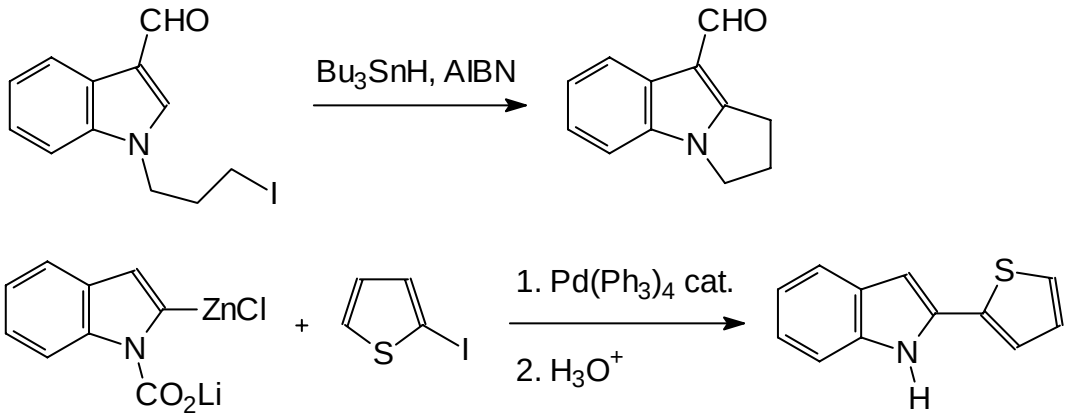


Electrophilic substitution at C-2 by attack at C-3 followed by rearrangement. i. EtMgBr; ii. $PhCH_2Br$; iii. HCl; iv. $(MeCO)_2O$, BF_3-ether.

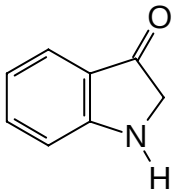


Lithiation of indoles at C-2 and electrophilic substitution.

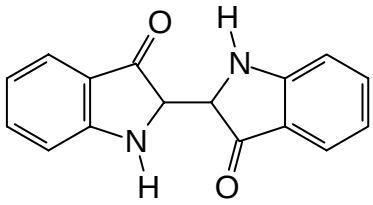
6.4.4 Radical substitution and coupling reactions



6.4.5 Oxidation and reduction



75



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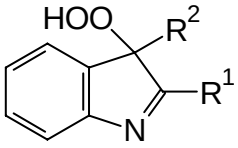

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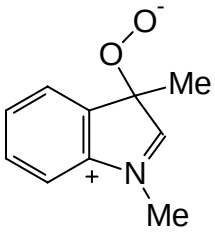

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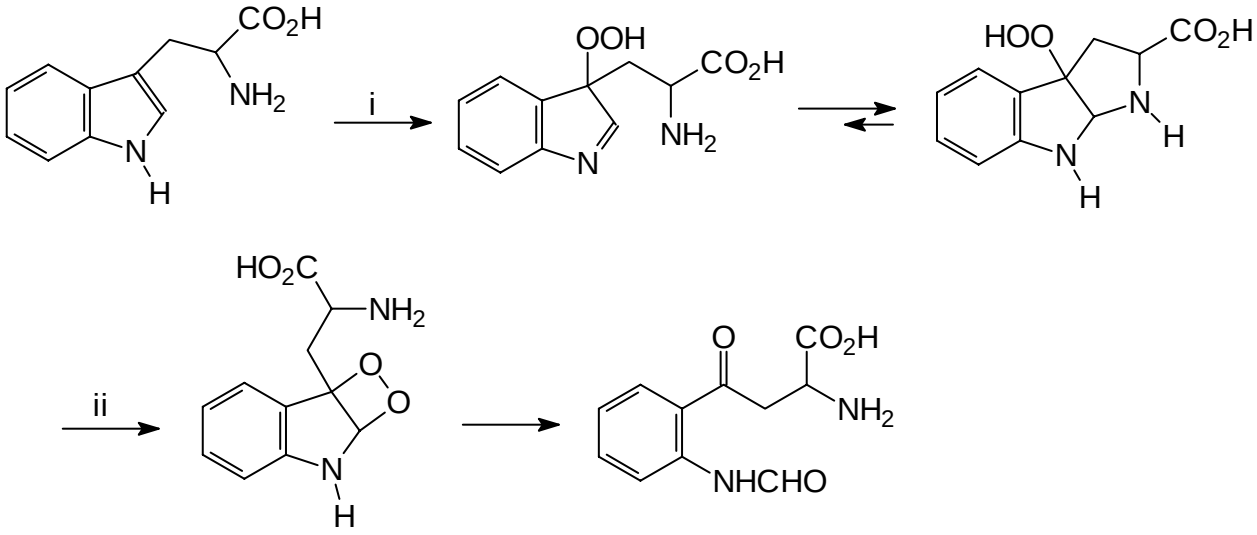
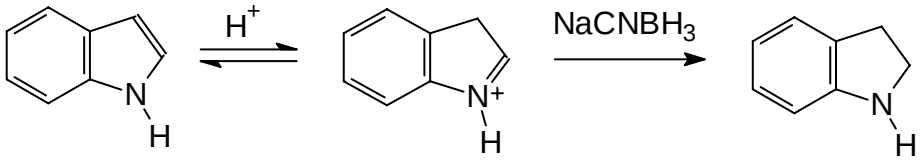
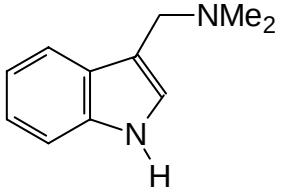


Oxidation of tryptophan. i. O_2, sens. hv; ii. Na_2CO_3 aq.



Reduction of indole

6.4.6 Properties of some substituted indoles



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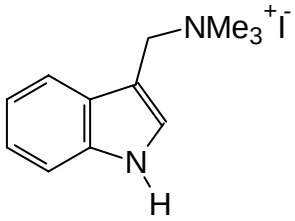

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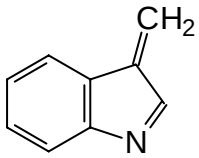

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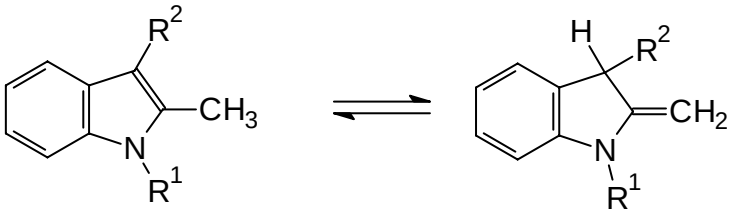
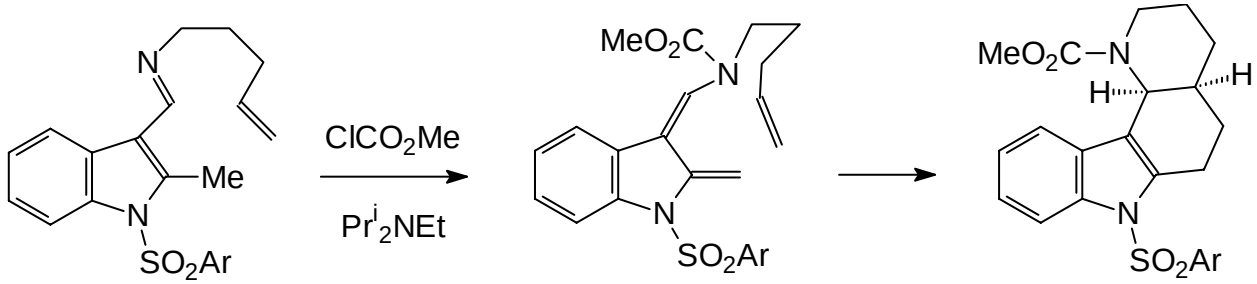


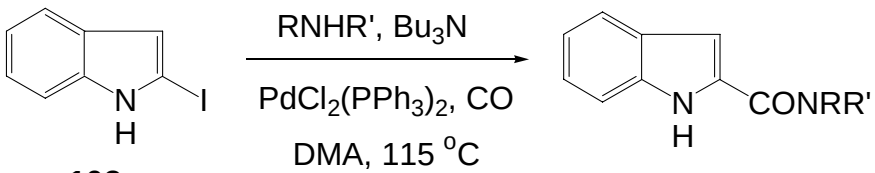
83 **84**



85 **86**

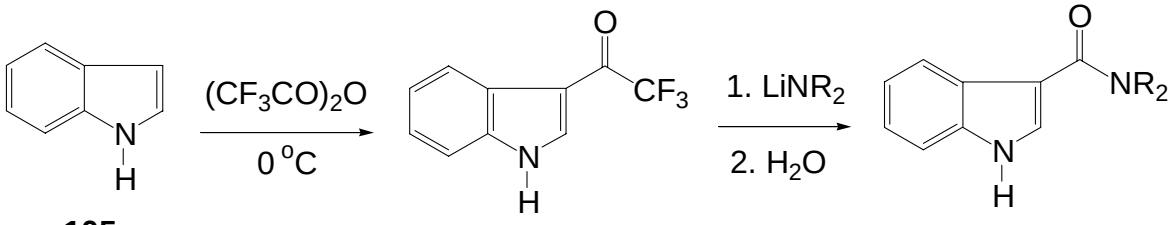
Generation and trapping of a transient diene.

6.4.7 Reactions of Indoles in 1998



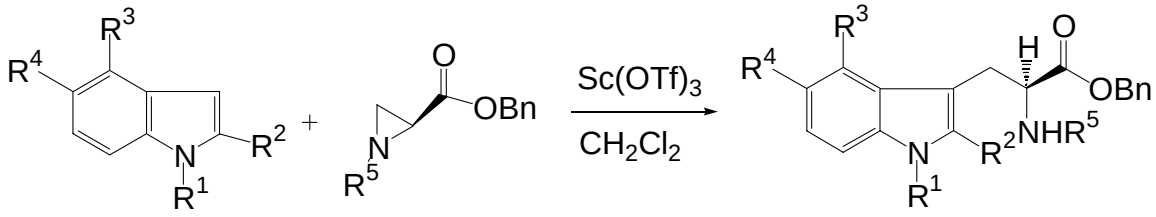
103 **104**

TL, 1998, 2421.



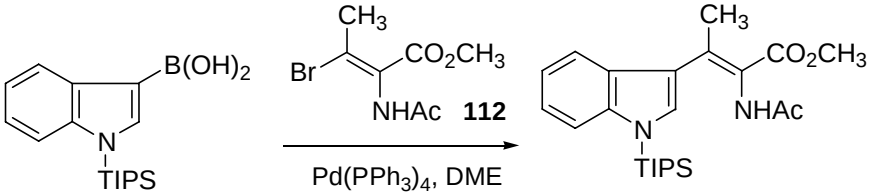
105 **106** **107**

TL, 1998, 3095.

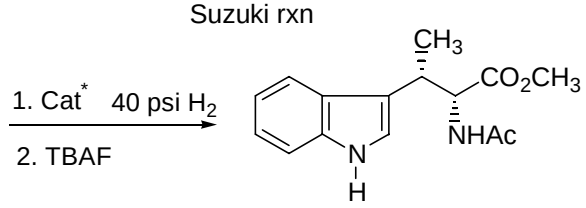


108 **109** **110**

Synlett, 1998, 754.



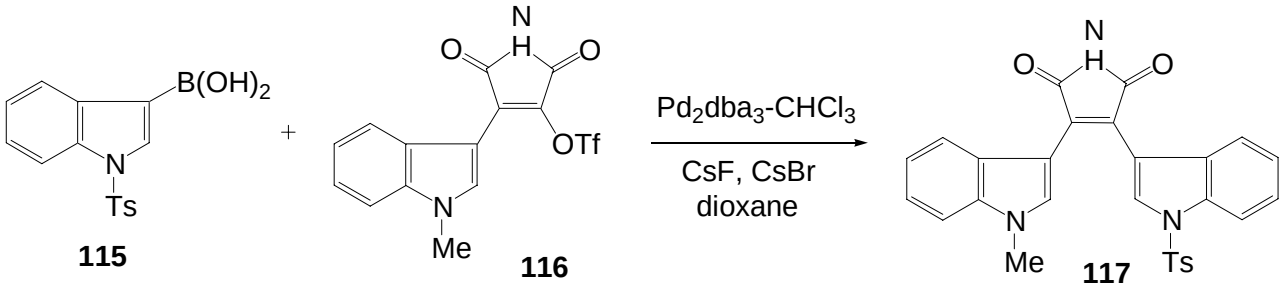
111 **112** **113**



114

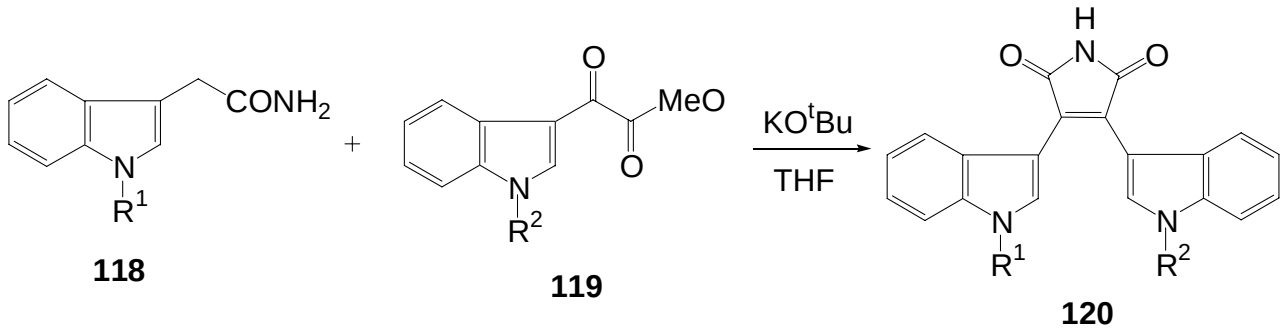
Cat* = (R,R) Me-DuPHOS-Rh

TL, 1998, 3455.



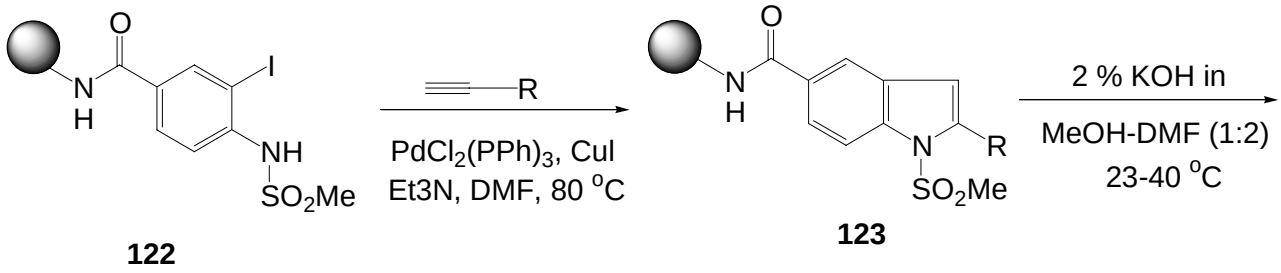
115 **116** **117**

TL, 1998, 1745.

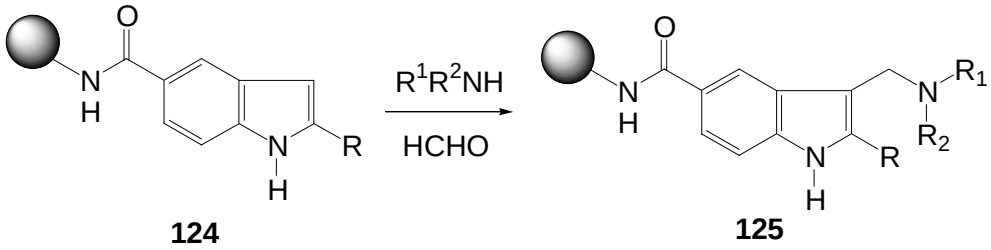


118 **119** **120**

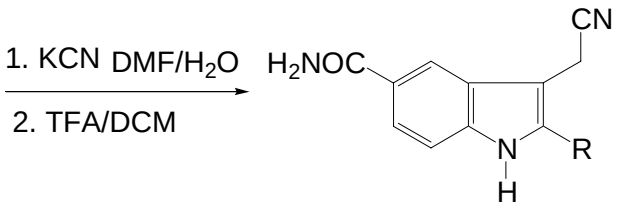
JOC, 1998, 1961.



122 **123**

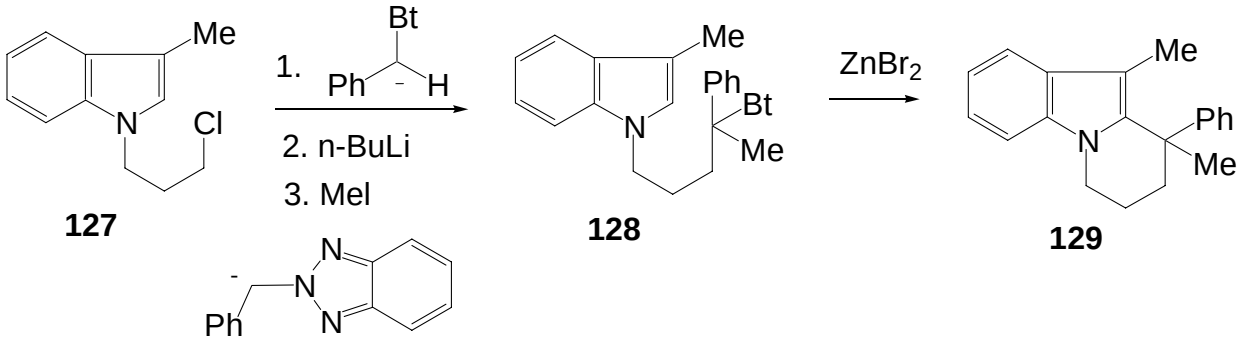


124 **125**



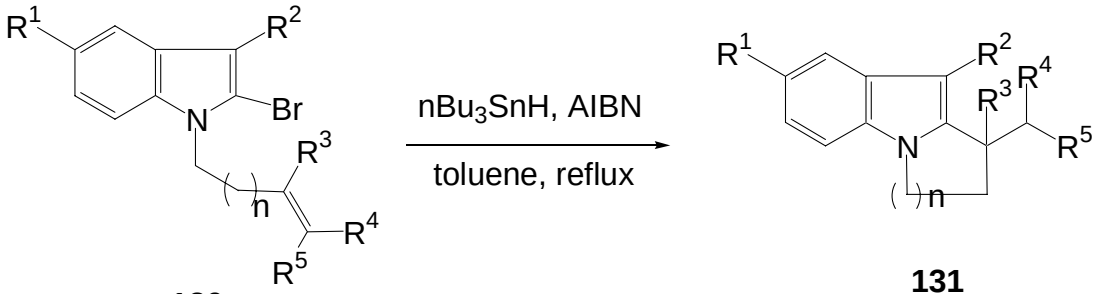
126

JOC, 1998, 5300.



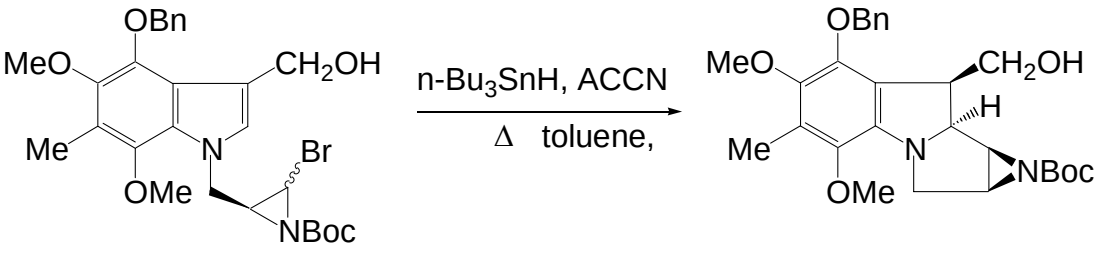
127 **128** **129**

JOC, 1998, 3445.



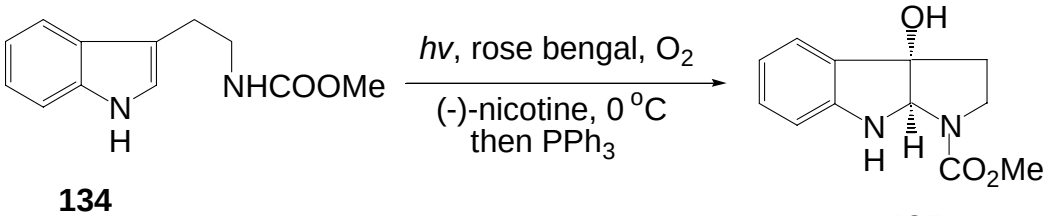
130 **131**

Tetrahedron, 1998, 2149.



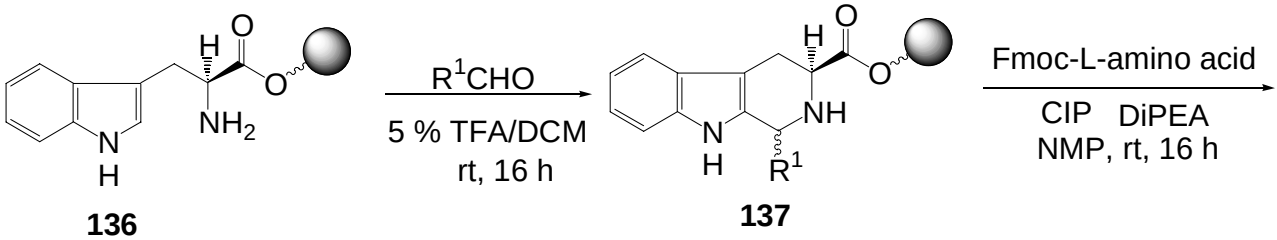
132 **133**

TL, 1998, 2455.

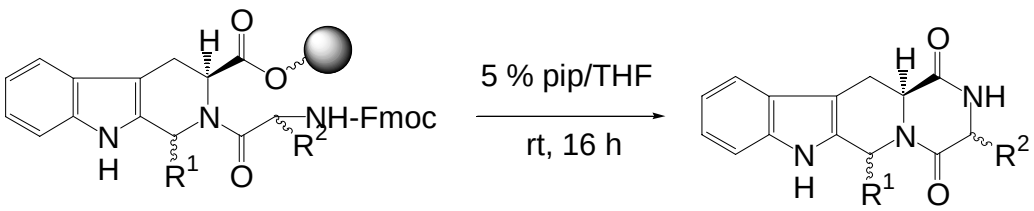


134 **135**

Synlett, 1998, 257.

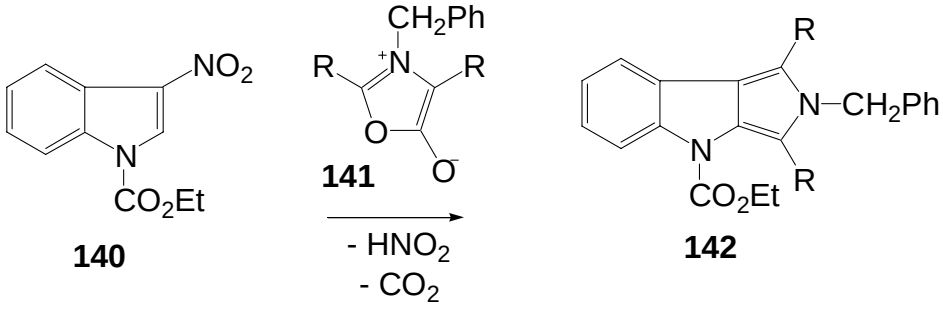


136 **137**

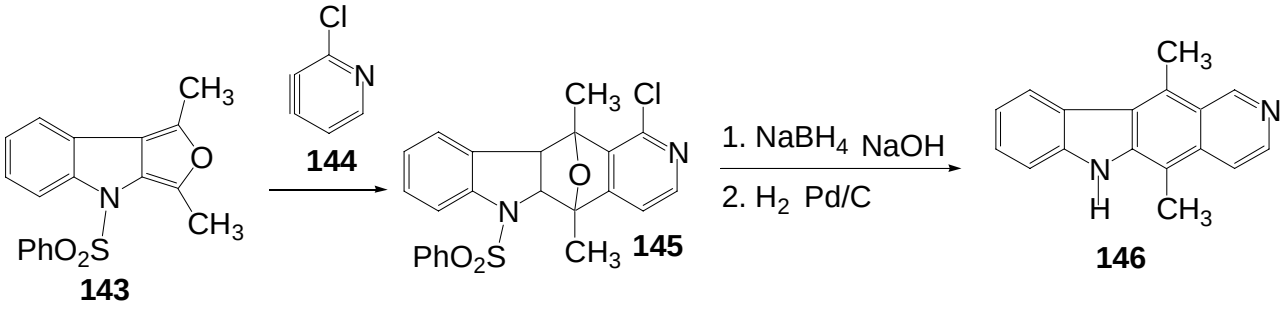


138 **139**

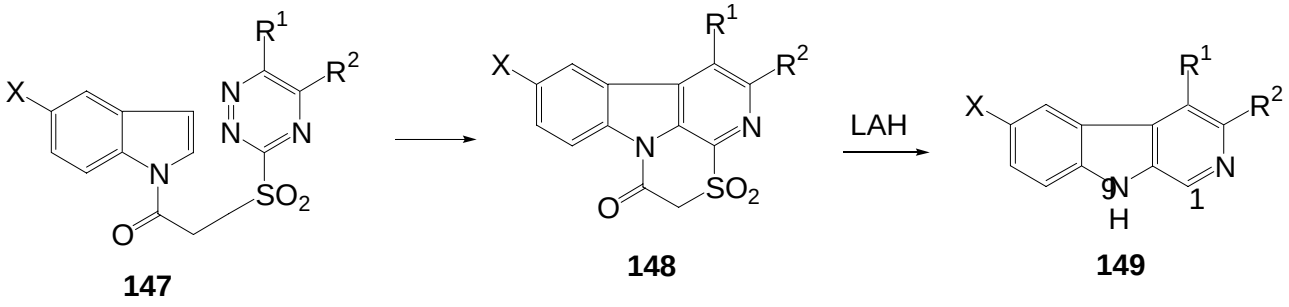
TL, 1998, 4737.



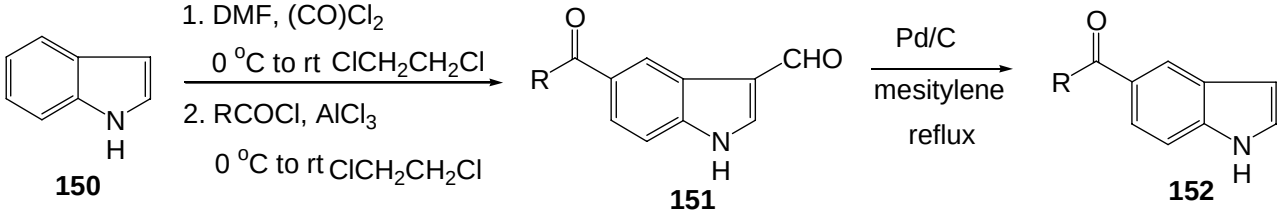
Synlett, 1998, 1061.



Synlett, 1998, 157.



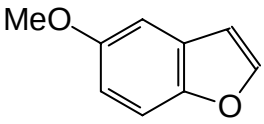
TL, 1998, 2487.



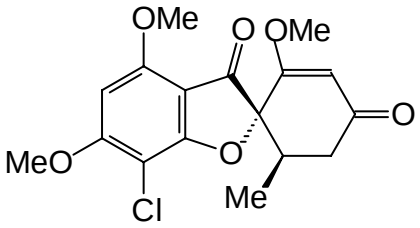
Synthesis, 1998, 1519.

6.5 Other benzo[b]-fused heterocycles

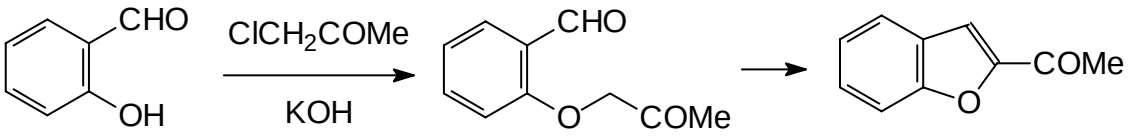
6.5.1 Benzofurans



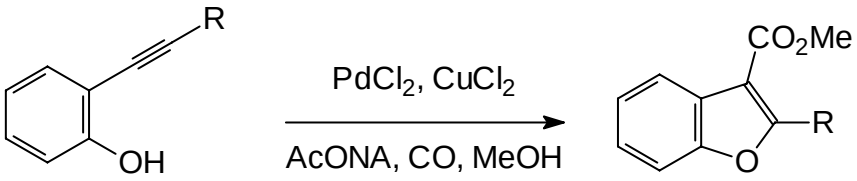
88

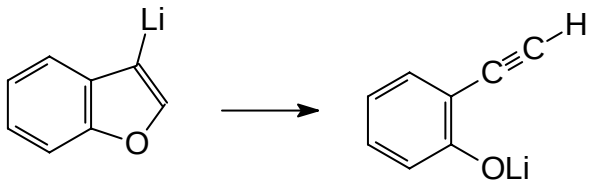


89

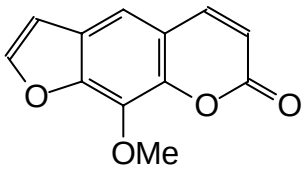


90





91



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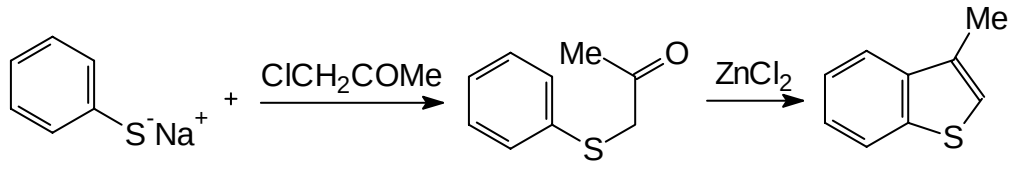
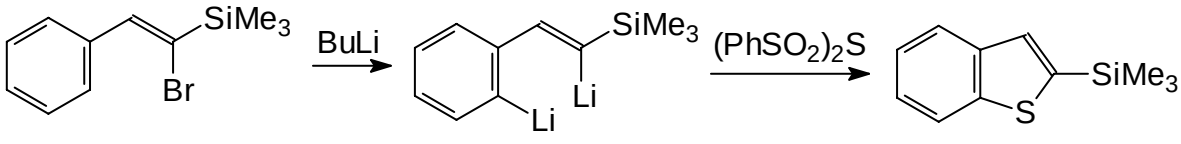
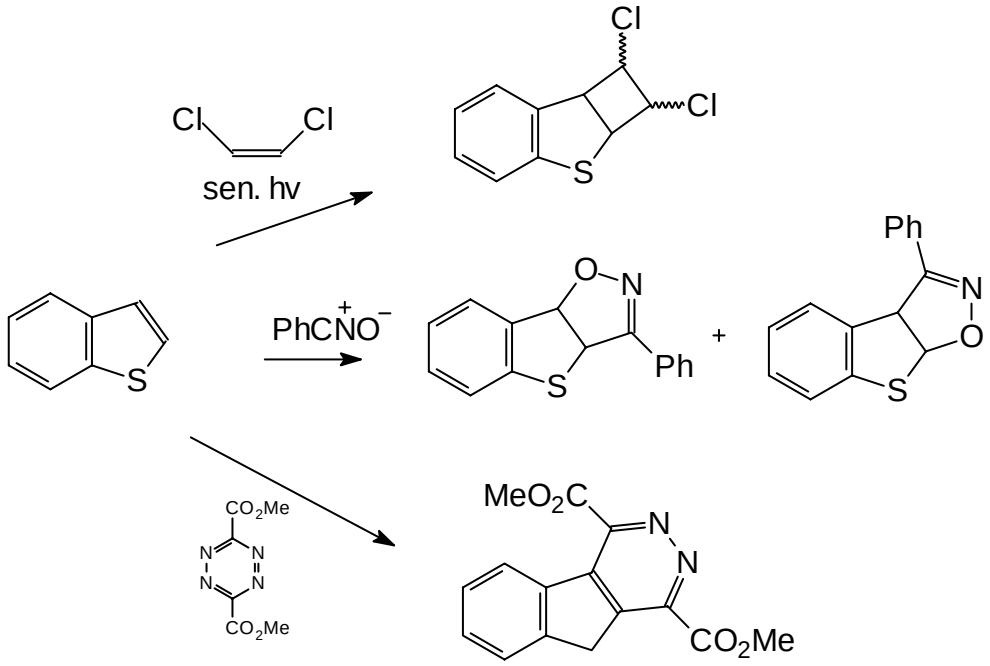
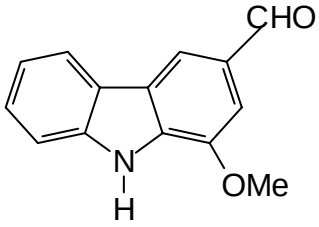
6.5.2 Benzo[b]thiophenes



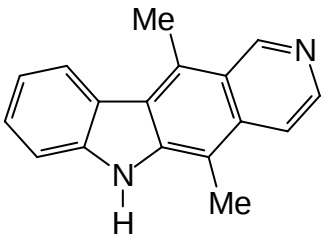




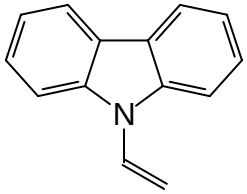
6.5.3 Carbazoles



93



94



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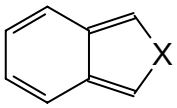
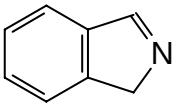
6.6 Benzo[c]-fused heterocycles

6.6.1 Introduction



96



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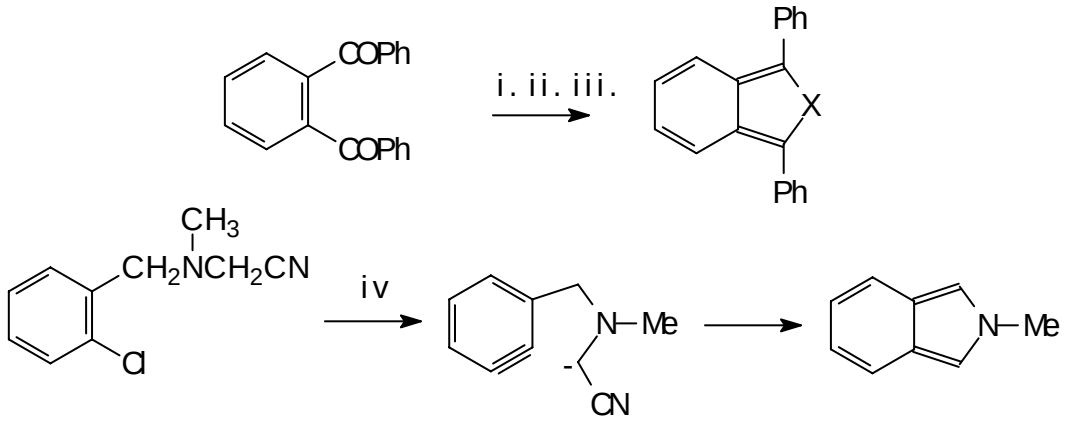
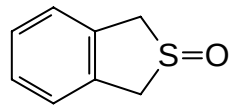
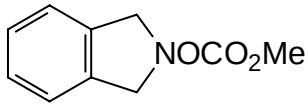
6.6.2 Synthesis



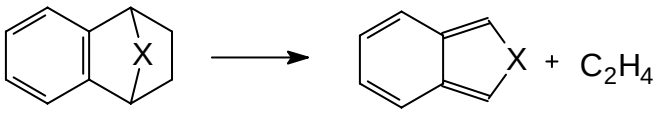
Ring synthesis by cyclization. Reagents: i. (for X = NMe), $MeNH_2$, $NaBH_4$; ii. (for X = O), KBH_4; iii. (for X = S), PCl_5, KSCSEt; iv, KNH_2, NH_3



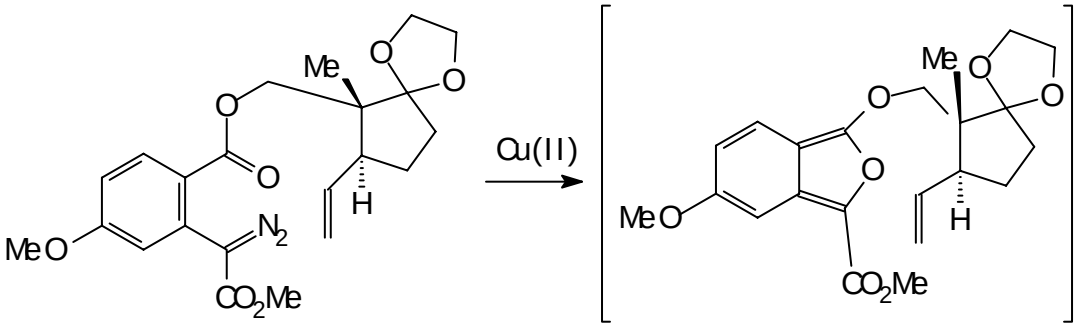
98

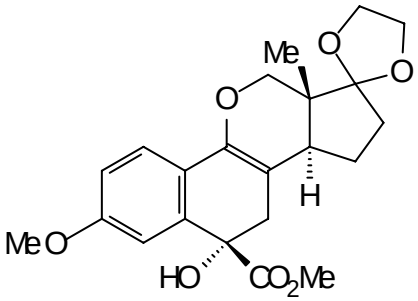


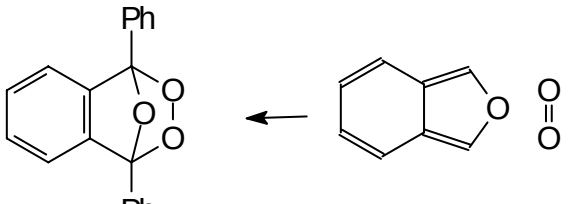
99



6.6.3 Chemical properties







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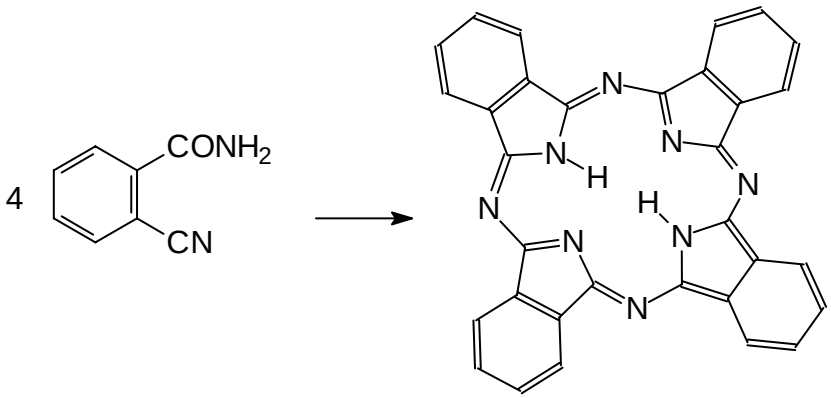
6.6.4 Phthalocyanines



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