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REACTIONS OF 2-CHLOROINDOLES: SYNTHESIS OF 2,2'-BIINDOLYLS

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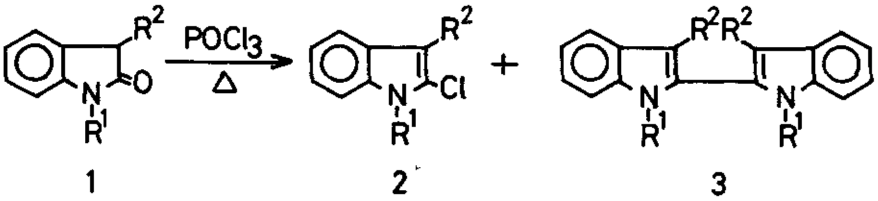
Abstract—— 3-Alkyl-2-chloroindoles(**2**) react with 3-alkylindoles(**4**) in the presence of boron trifluoride etherate to afford 3,3'-dialkyl-2,2'-biindolyls(**3**) in good yields.

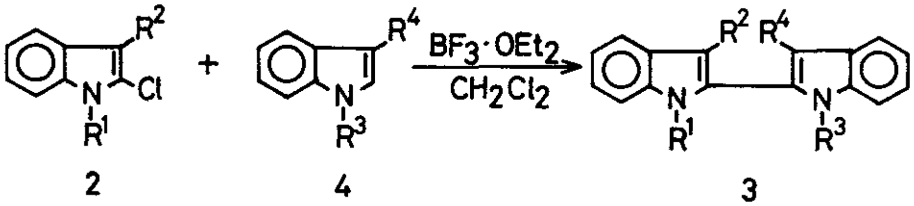
We have recently described an efficient method for the conversion of 2-indolinones (**1**) into indoles via 2-chloroindoles(**2**), which were easily prepared from 2-indolinones(**1**) and phosphoryl chloride by heating in neat liquid under nitrogen.[1]
In this chlorination reaction, 1,3-dimethyl-2-indolinone(**1**a) was observed to afford the desired 2-chloroindole(**2**a) and 1,1',3,3'-tetramethyl-2,2'-biindolyl(**3**a). The product distribution was found to depend on the reaction conditions(Table 1) and the formation of 2,2'-biindolyl(**3**a) can be explained by the acid-catalyzed dimerization of 2-chloroindole(**2**a).
Since only a few studies on the chemical properties of 2,2'-biindolyls(**3**) have been reported,[2] we examined the dimerization reactions of 2-chloroindoles(**2**) and their reactions with 3-alkylindoles(**4**) leading to 2,2'-biindolyls(**3**) in the presence of boron trifluoride etherate.[3]
Treatment of 2-chloro-1,3-dimethylindole(**2**a) in methylene chloride with 1,3-dimethylindole(**4**a) in the presence of boron trifluoride etherate at 0°C for 30 min, and then at room temperature for 15 h provided a 91.2% yield of 1,1',3,3'-tetramethyl-2,2'-biindolyl(**3**a)[m.p. 211-212°; M^+ 288(100%); ^{1}H n.m.r. δ($CDCl_3$) 2.22(6H, s,$2xC_3$-CH_3), 3.53(6H,s,2xN-CH_3), 7.07-7.40(6H,m,ArH), 7.56-7.72(2H,m,ArH); ^{13}C n.m.r. δ($CDCl_3$) 9.4(q,$2xC_3$-CH_3), 30.3(q,2xN-CH_3)].
When the other 3-alkyl-2-chloroindoles(**2**b-c) were treated with 3-alkylindoles(**4**) under similar conditions the corresponding 2,2'-biindolyls(**3**b-d) were obtained in good yields(Table 2).[4]

Table 1 Chlorination of 3-Alkyl-2-indolinones(1) with Phosphoryl Chloride



	R^1	R^2	Reaction conditions	Product	Yield [%]	Product	Yield [%]
1a	CH_3	CH_3	110°/ 5 min	2a	38.3	3a	3.4
			110°/ 25 min		——		24.6
			80°/ 35 min		82.8		——
1b	CH_3	C_2H_5	110°/ 5 min	2b	59.0	3b	——
			110°/2.5 h		——		17.2

Table 2 Reactions of 3-Alkyl-2-chloroindoles(2) with 3-Alkyl-indoles(4) and Dimerization Reactions of 3-Alkyl-2-chloroindoles(2)



Product	R^1	R^2	R^3	R^4	Reaction conditions	Yield [%]	m.p.[°C](solvent)
3a	CH_3	CH_3	CH_3	CH_3	r.t./ 12 h	91	211-212°(CH_2Cl_2-hexane)
3a	CH_3	CH_3	CH_3	CH_3	60°/ 24 h	8^a	
3b	CH_3	C_2H_5	CH_3	C_2H_5	r.t./ 2 day	80	111-113°(CH_2Cl_2-hexane)
3b	CH_3	C_2H_5	CH_3	C_2H_5	60°/ 24 h	19^a	
3c	CH_3	C_2H_5	CH_3	CH_3	r.t./ 12 h	99	164-165°(CH_2Cl_2-hexane)
3d	H	CH_3	H	CH_3	r.t./ 4 day	89	163-165°(ether-ptr.ether) (ref.[5] 162-163°)

[a] Dimerization reaction

On the other hand, the dimerization reactions of 3-alkyl-2-chloroindoles(**2**a-b) afforded 2,2'-biindolyls(**3**a-b) in rather low yields(Table 2) and this indicates that the electron-withdrawing substituent of unprotonated **2**a-b decreases reactivity toward the electrophile, *i.e.*, 1,3-dialkyl-2-chloroindoleninium ion.

Acknowledgements

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REFERENCES AND NOTES

1. A.Kubo and T.Nakai, Synthesis, 1980, 365.
2. J.Bergman and N.Eklund, Tetrahedron, 1980, **36**, 1439 and references therein.
3. 2-Ethoxyindole is known to dimerize in the presence of boron trifluoride etherate to give 2-(2-ethoxyindol-3-yl)indole in 35% yield. H.Plieninger and D.Wild, Chem. Ber., 1966, **99**, 3063.
4. Satisfactory spectroscopic and analytical or accurate mass data have been obtained for all new compounds.
5. (**3**d) was obtained from the dehydrogenation of the 3-methyl-2-(3-methylindolin-2-yl)indole(skatole dimer) with chloranil in benzene. G.Berti, A.Da Settimo, and D.Segnini, Tetrahedron Letters, 1960, **26**, 13. A.Z.Britten and G.F.Smith, J. Chem. Soc., Perkin Trans. 1, 1972, 418.

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