A NOVEL ASPECT OF THE 1,2-ALKYL MIGRATION REACTION WITH TRIALKYL 1-SUBSTITUTED INDOL-2-YLBORATES

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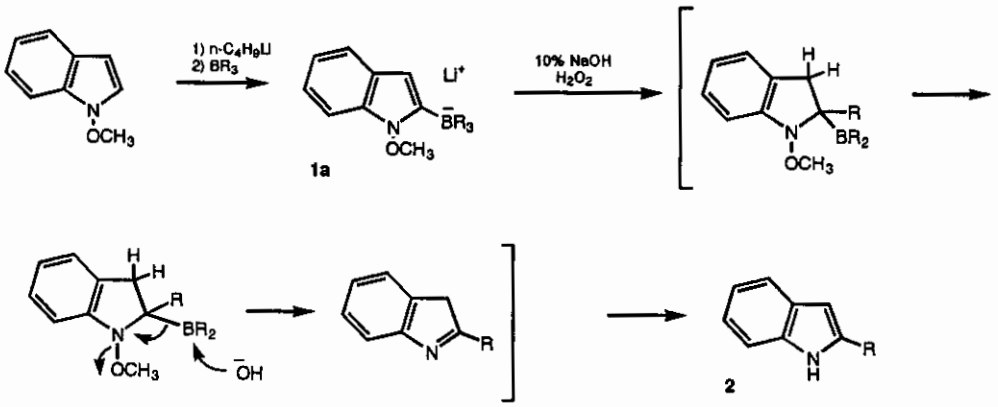
Abstract - Intramolecular 1,2-alkyl migration reaction of trialkyl(1-methoxyindol-2-yl)borates and trialkyl(1-methoxymethylindol-2-yl)-borates gave rise to 2-alkylindoles and 2-alkyl-1-methylindoles, respectively.

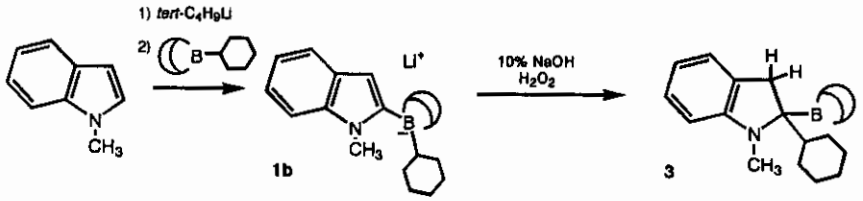
Developing the synthetic advantages of indolylborate has been our current interest, and the investigations have been mainly done with trialkyl(1-methylindol-2-yl)borate due to its ready availability and sufficient reactivity.[1] During the recent work aimed at substituting the rigid *N*-methyl group of the indolylborate for adequately removable *N*-protecting group, we found (i) a facile formation of 2-alkylindoles from trialkyl(1-methoxyindol-2-yl)borate (**1a**) and (ii) the formation of 2-alkyl-1-methylindoles from trialkyl(1-methoxymethylindol-2-yl)borate (**1c**) involving unexpected reduction of methoxymethyl group to methyl group, and these results are reported in this paper.

Treatment of 2-lithio-1-methoxyindole (derived from 1-methoxyindole and *n*-BuLi in THF at -20°C)[2] with trialkylborane for 2 h generated borate (**1a**) *in situ*, and subsequent addition of 10% aqueous NaOH and 30% aqueous H_2O_2 under ice-cooling afforded 2-alkylindoles (**2**), which involves 1,2-alkyl migration and susequent elimination of methoxy group as depicted in Scheme 1. On the other hand, borane (**3**)[3] was isolated as air stable crystals in 20% yield from the reaction with 1-methylindolylborate (**1b**) under similar conditions.



BR_3	R in **2**	Yield (%) of **2**
$B(CH_2CH_3)_3$	$-CH_2CH_3$	90
$B(CHCH_2CH_3)_3$ (CH3)	$-CHCH_2CH_3$ (CH3)	89
B-$(CH_2)_5CH_3$	$-(CH_2)_5CH_3$	60
B-C6H5	-C6H5	60

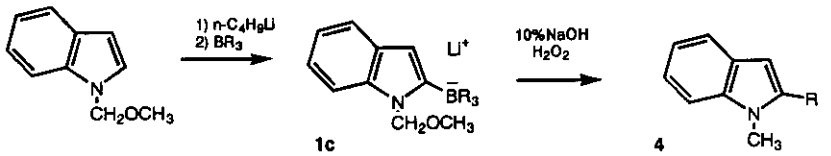
B- = 9-borabicyclo[3,3,1]nonanyl

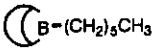
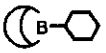


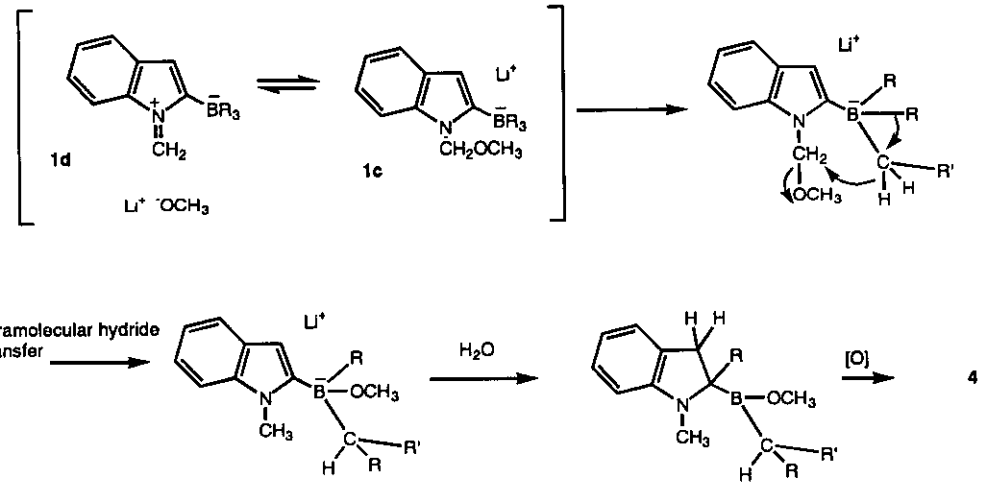
Scheme 1

On subjection of borate (**1c**) (generated *in situ* from 1-methoxymethylindole and *n*-BuLi in THF at -20°C for 20 min, followed by treatment with trialkylborane) to the reaction under the same conditions as above, 2-alkyl-1-methylindoles (**4**) were unexpectedly isolated (Scheme 2), wherein an intramolecular hydride transfer process may be envisioned. Tetraalkylborate has a high propensity to transfer intermolecularly one of the α-hydrogens in the presence of a reducible substrate such as allyl halide, ketone, or acyl halide.[4] Therefore, the highly reducible nature of the methoxymethyl group in borate (**1c**), due to the equilibrium (**1c** $\rightleftharpoons$ **1d**), enhanced by increased electron density at nitrogen of the carbinolamine

moiety, as well as the intramolecular manner of the hydride transfer, is greatly responsible for the present reduction.



BR_3	R in 4	Yield (%) of 4
$B(CH_2CH_3)_3$	$-CH_2CH_3$	60
$B(CHCH_2CH_3)_3$ CH_3	$-CHCH_2CH_3$ CH_3	61
	$-(CH_2)_5CH_3$	30
		25



Scheme 2

REFERENCES AND NOTES

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2. K. Nakagawa and M. Somei, *Heterocycles*, 1994, **39**, 31; F. Yamada, Y. Fukui, D. Shinmyo, and M. Somei, *ibid.*, 1993, **35**, 99; M. Somei and T. Kobayashi, *ibid.*, 1992, **34**, 1295; M. Somei, *Yuki Gosei Kagaku Kyokai Shi*, 1991, **49**, 205.

3. Analytical and spectral data for borane (**3**): Anal. Calcd for $C_{23}H_{34}NB$: C, 82.38; H, 10.22; N, 4.17. Found: C, 82.29; H, 10.31; N, 4.19. ^{1}H Nmr ($CDCl_3$) δ: 0.30-0.60 (br, 2H), 0.70- 2.10 (m, 23H), 2.80 (1H, d, J=16 Hz), 2.93 (s, 3H), 3.29 (d, 1H, J=16 Hz), 6.80-7.30 (m, 4H). ^{13}C Nmr ($CDCl_3$) δ: 23.9, 26.2, 26.7, 27.1, 28.4, 31.4, 31.7, 32.5, 35.3, 39.0, 115.3, 124.5, 124.7, 126.4, 137.2, 149.2. Ms: m/z 334 and 335 (M^+).

4. G. W. Kramer and H. C. Brown, *J. Am. Chem. Soc.*, 1976, **98**, 1964; Y. Yamamoto, H. Toi, A. Sonoda, and S. -I. Murahashi, *J. Chem. Soc., Chem. Commun.*, 1976, 672; Y. Yamamoto, H. Toi, S. -I. Murahashi, and I. Moritani, *J. Am. Chem. Soc.*, 1975, **97**, 2558; H. Jager and G. Hesse, *Chem. Ber.*, 1962, **95**, 345.

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