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A PRONOUNCED TEMPERATURE EFFECT IN THE REACTION OF 1,3,5-TRIFLUOROBENZENE WITH t-BUTYLLITHIUM

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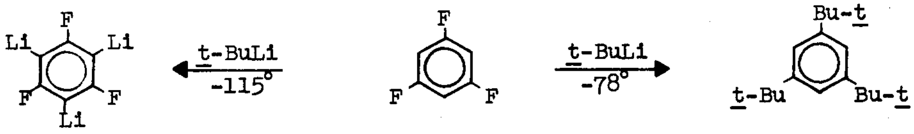
During a study designed to develop suitable synthetic procedures for the preparation of some polyhalo-polylithio-aryl types required as intermediates, an apparent failure of t-butyllithium to provide any lithiated species upon reaction with 1,3,5-trifluorobenzene [I] was observed.[1] This result was surprising in view of the fact that n-BuLi, under similar conditions, has been shown to give a tri-lithiated product upon reaction with [I],[1] with 1,3,5-trichlorobenzene,[2] and with 1,3,5-trichloro-2,4,6-trifluorobenzene.[3] The product obtained from reaction of 4.0 equivalents of t-BuLi with [I] at -70° in THF/pentane (ca. 50/50) solvent mixture was 1,3,5-tris(t-butyl)benzene [II] in 72% yield.[1] In a subsequent experiment, slow addition of 4.0 equivalents of t-BuLi at -78° provided [II] (65%), and 1,3,5-trifluoro-2,4,6-trilithiobenzene [III] (ca. 5%) based on isolation of 1,3,5-trifluoro-2,4,6-tris(trimethylsilyl)benzene [IV] after derivitization with $ClSiMe_3$. One equivalent of t-BuLi, added slowly at -78°, provided 1,3,5-trifluoro-2-lithiobenzene (64%) and 1,3,5-trifluoro-2,4-dilithiobenzene (18%). The rapid formation of these metalated products suggested that t-BuLi might be used to form [III] in high yield. When 3.15 equivalents of t-BuLi were slowly added to [I] at -115° in THF/pentane (initially 90/10, finally ca. 50/50), [III] was obtained in nearly quantitative yield. The yields of [III] in two independent reactions were 95 and 96% based



[III] [I] [II]

on isolated yields of [IV]. The chief contaminant was [II] (ca. 1%). It appears that at a temperature slightly below -115° the trilithio compound [III] may be formed in quantitative yield. Lesser yields of [III] were obtained in the reaction of *n*-BuLi with [I], or *n*-BuLi with 1,3,5-trichloro-2,4,6-trifluorobenzene.[3]

The dramatic temperature effect upon the course of the reaction with *t*-BuLi was not apparent with *n*-BuLi which reacted very slowly with [I] below -70°, and gave a large amount of intractable pot residue at temperatures above -60°. The enhanced metalating abilities of *t*-BuLi *vs*. *n*-BuLi has been attributed to a greater tendency of the less stable *t*-butyl anion to donate an electron to an aromatic system and so give the more stable *t*-butyl radical.[4] It was shown that there is little steric requirement difference in the metalation of aromatic systems with *t*-BuLi *vs*. *n*-BuLi.[4]

Alkylation products have been observed in reactions of an alkyllithium with aromatic[5-7] or with halo-aromatic[8-10] compounds. The former have been shown to proceed by an addition-elimination mechanism while the latter presumably involve a benzyne intermediate. The pronounced difference in the reaction of [I] with *t*-BuLi *vs*. *n*-BuLi at -70° may be the result of an addition-elimination mechanism operative with *t*-BuLi at this temperature. The formation of the large amount of intractable pot residue with *n*-BuLi at higher temperatures may be due to decomposition through a benzyne intermediate as suggested for *o*-lithiofluorobenzene.[8,11]

The structures of the compounds were established by elemental analyses; by ^{19}F NMR; and by comparison with authentic samples of [II][12] and [IV].[13]

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12. We are grateful to Professor Philip C. Myhre for a sample of [II].
13. Professor Nobuo Ishikawa kindly provided an authentic specimen of 1,3,5-trifluoro-2,4,6-*tris*(trimethylsilyl)benzene [IV] which was formed from the intermediate [III] by derivatization with $ClSiMe_3$.