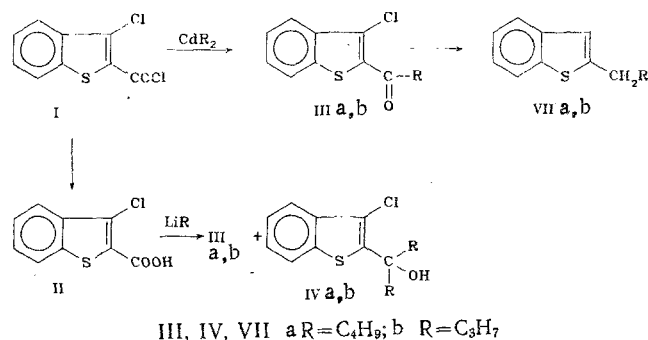


G. L. Savinov, Yu. V. Savinykh,
and V. S. Aksenov

UDC 547.735.07:543.422

The treatment of 3-chlorobenzo[b]thiophene-2-carbonyl chloride with diethyl- or dipropylcadmium leads to the corresponding ketones, and the treatment of the acid itself with butyl- or propyllithium leads to ketones in admixture with the tertiary alcohol. The subsequent reduction of the ketones obtained with hydrazine hydrate and hydriodic acid has given 2-alkylbenzo[b]thiophenes.

As already reported [1], the arylation of acrylic acid with aromatic iodine derivatives followed by oxidation of the α -substituted acrylic acid formed with thionyl chloride permits benzo[b]thiophenes with alkyl substituents in the benzene ring to be obtained. The acid chloride group in position 2 of the benzo[b]thiophene ring formed in the last reaction can be used for the introduction of an alkyl substituent into the thiophene ring. With this aim, we have investigated the reaction of 3-chloro-2-chlorocarbonylbenzo[b]thiophene (I) and the corresponding acid (II) with organolithium and organocadmium compounds.



The acid (II) was obtained from its chloride (I) by a method described previously [1]. When the acid (II) reacted with butyllithium, two products were found in the reaction mixture by the GLC method — butyl 3-chlorobenzo[b]thienyl ketone (IIIa), and the tertiary alcohol (IVa). The ratio between the amounts of the ketone (IIIa) and the alcohol (IVa) depended on the reaction temperature: (IVa)/(IIIa) = 1 (20°C); (IVa)/(IIIa) = 0.4 (−30°C) (according to GLC analyses of the reaction mixture), but did not depend on the time of the reaction. The ketone (IIIa) and the alcohol (IVa) were isolated by adsorption chromatography on silica gel, and their structures were determined with the aid of IR and PMR spectroscopy and elementary analysis (see Table 1). The results obtained showed that the use of organolithium compounds for the synthesis of 2-alkylbenzo[b]thiophenes is unsuitable because of the low yield of ketone (~23%) and the formation of a by-product (about 10%). The formation of the tertiary alcohol in the reaction of organolithium compounds with organic acids has been detected by other workers [2], as well.

The best results were obtained when using organocadmium compounds. In contrast to literature information for other substances [3], the reaction products contained, according to GLC, about 15% of unidentified products (the dibutylcadmium apparently contains residual amounts of butylmagnesium bromide; the treatment of the dibutylcadmium with acetone led to the disappearance of the by-products). The reaction of dibutylcadmium with the acid chloride (Ia) at 10°C gave the ketone (IIIa) with a yield of 42%. The use of a large excess of dibutylcadmium (more than three times the equimolar amount) and a lengthening of the reaction time did not lead to

TABLE 1. Characteristics of the Compounds Synthesized

Compound	mp, °C	PMR spectrum, ppm	IR spectrum, cm ⁻¹	Found, %				Empirical formula	Calculated, %				Yield, %
				C	H	Cl	S		C	H	Cl	S	
IIIa	86,5—87,2	0,9 (3H); 1,5 (4H); 3,0 (2H); 7,4 (2H); 7,7 (2H)	1670, 730	61,9	5,2	14,2	12,7	C ₁₃ H ₁₃ ClOS	61,8	5,2	14,1	12,7	23 (42)
IIIb	84,9—85,8	0,9 (3H); 1,5 (2H); 3,0 (2H); 7,4 (2H); 7,7 (2H)	1660, 730	60,9	4,6	14,7	13,5	C ₁₂ H ₁₁ ClOS	60,4	4,6	14,9	13,4	26 (46)
IVa	—	0,8 (6H); 1,2 (8H); 2,3 (1H); 1,7 (4H); 7,2 (2H); 7,7 (2H)	3490, 720	65,9	7,6	11,3	10,2	C ₁₇ H ₂₃ ClOS	65,7	7,4	11,4	10,3	8 (—)
VIIa	155,5—155,9	0,8 (3H); 1,2 (6H); 2,8 (2H); 6,8 (1H); 7,1 (2H); 7,5 (2H)	720	76,4	7,5		15,7	C ₁₃ H ₁₄ S	76,5	7,8		15,7	52
VIIb	152—153	0,8 (3H); 1,4 (4H); 2,7 (2H); 6,8 (1H); 7,1 (2H); 7,5 (2H)	720	75,8	7,4		16,8	C ₁₂ H ₁₂ S	75,8	7,4		16,8	48

*For compounds (IIIa, b) and (IVa) the yields when using di-n-butylcadmium are given in parentheses, the figures without parentheses being for butyllithium.

an appreciable increase in the yield of desired products. Raising the reaction temperature to 60°C lowered the yield of ketone (IIIa) to 13% because of the resinification of the reaction mixture.

The subsequent reduction of the ketones obtained caused no particular difficulties. However, in the reduction of the ketone (IIIa) or (IIIb) by the Wolff-Kishner reaction in the Huang-Minlon modification, in addition to 2-amyl-3-chlorobenzo[b]thiophene (VIa) a compound (V) was formed which, according to IR spectroscopy, contained an OH group (strong broad band with a maximum at 3460 cm⁻¹) and on reduction with hydriodic acid, like the 2-amyl-3-chlorobenzo[b]thiophene (VIa) it gave 2-amylbenzo[b]thiophene (VIIa). The structure of (V) has not been studied in detail. The structures of the alkylthiophenes (VII) were confirmed by their spectral characteristics (see Table 1).

The reduction of 3-chlorobenzo[b]thiophenes with hydriodic acid has been described previously [1].

Thus, in this investigation we have shown the basic possibility of synthesizing 2-alkylbenzo[b]thiophenes from the readily available 3-chloro-2-chlorocarbonylbenzo[b]thiophene using dialkylcadmiums.

EXPERIMENTAL

IR spectra were recorded on a UR-20 instrument in a thin layer or in CCl₄ solution, and PMR spectra on a Tesla BS-487 spectrometer using HMDS as internal standard. GLC analysis was performed on Tsvet-102 chromatograph with a flame-ionization detector using nitrogen as the carrier gas and a column (2 m × 3 mm) containing 3% of the stationary phase SE-30 or SP-2100 on Inerton-super.

2-Acyl-3-chlorobenzo[b]thiophene (IIIa). A. At -30°C, 12 g (0.084 mole) of an alkylolithium obtained as described by Talalaeva and Kocheshkov [4], in ether, was added dropwise to 3.0 g (0.014 mole) of the thiophene (II) in 60 ml of benzene. The reaction mixture was stirred at the same temperature for 3 h, and then 100 ml of water and hydrochloric acid to pH 1 was added, and the organic layer was separated off, dried with magnesium sulfate, and evaporated, and the residue was dissolved in boiling hexane. When the hexane solution was cooled to 0°C, crystals of the ketone (IIIa) deposited. The ketone (IIIb) was obtained similarly. The characteristics of the ketones obtained are given in Table 1.

The mother solution after the separation of the crystals of the ketone (IIIa) was passed through a Schott filter with a diameter of 1.5 cm filled with ASK silica gel (0.25 mm) to a

height of 3 cm. The silica gel was washed with toluene and then with acetone. The tertiary alcohol (IVa) was concentrated in the acetone fraction. After the acetone had been distilled off, 0.35 g (8%) of (IVa) was obtained.

B. In portions, 8.24 g (0.045 mole) of anhydrous cadmium chloride and 60 ml of benzene were added to 14.49 g (0.09 mole) of butylmagnesium bromide in 80 ml of ether, and then the ether was distilled off and the mixture was boiled for 2 h. The resulting diethylcadmium was treated with 5 ml of acetone, and then 3.5 g (0.015 mole) of the acid chloride (I) in 50 ml of benzene was added dropwise. The resulting mixture was stirred at 22°C for 3 h 30 min. Then it was worked up by method A. The ketones obtained by method A and B did not differ according to their spectral characteristics and melting points.

2-Alkylbenzo[b]thiophenes (VII). Dropwise 10.2 g (0.2 mole) of hydrazone hydrate was added to 0.049 mole of one of the ketones (IIIa and b) in 70 ml of diethyleneglycol, and the mixture was heated to 140°C over 1 h 30 min with the simultaneous elimination of water by distillation. After this, 5.6 g (0.1 mole) of potassium hydroxide was added and the mixture was heated to 180°C for 2 h and was then cooled to room temperature and treated with 300 ml of water. The resulting mixture was extracted three times with hexane, and the hexane was distilled off. The reaction product obtained was reduced with hydriodic acid as described previously [1] (see Table 1).

LITERATURE CITED

1. T. N. Sidorenko, G. A. Terent'eva, V. S. Raida, O. S. Andrienko, Yu. V. Savinykh, and V. S. Aksenov, *Khim. Geterotsikl. Soedin.*, No. 12, 1618 (1982).
2. C. K. Brandsher and S. T. Webster, *J. Am. Chem. Soc.*, **79**, 393 (1957).
3. J. Cason and F. Prout, *Org. Synth.*, **28**, 60 (1948).
4. T. V. Talalaeva and K. A. Kocheshkov, *Methods of Organometallic Chemistry: Lithium, Sodium, Potassium, Rubidium, Cesium* [in Russian], Nauka, Moscow (1971), Book 1, p. 99.

MESOIONIC COMPOUNDS WITH A BRIDGE NITROGEN ATOM.

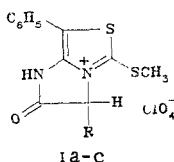
9.* IMIDAZO[1,2-c]THIAZOLES

E. K. Mikitenko and N. N. Romanov

UDC 547.789.67'783.07:668.819.45:543.422

5-Methylthio-2-oxo-2,3-dihydro-1H-imidazo[1,2-c]thiazolium salts readily react with 3-ethylrhodanine, p-dimethylaminobenzaldehyde, and 3-ethyl-2-methylbenzothiazolium tosylate with the formation of polymethine dyes, including dyes with a mesoionic structure. Reaction with acetic anhydride has given acetyl-substituted imidazothiazolium 2-oxides.

New derivatives (Ia-c) of a little-studied heterocyclic system — imidazo[1,2-c]thiazole — have been synthesized previously [2]. It appeared of interest to investigate the chemical reactions of these compounds.



Ia R=H, b R=CH₃, c R=C₆H₅

*For communication 8, see [1].

Institute of Organic Chemistry, Academy of Sciences of the Ukrainian SSR, Kiev. Translated from *Khimiya Geterotsiklicheskih Soedinenii*, No. 1, pp. 36-39, January, 1984. Original article submitted July 5, 1982; revision submitted December 21, 1982.