A CONVENIENT METHOD OF SYNTHESIS OF 1,3-DISUBSTITUTED PYRROLES

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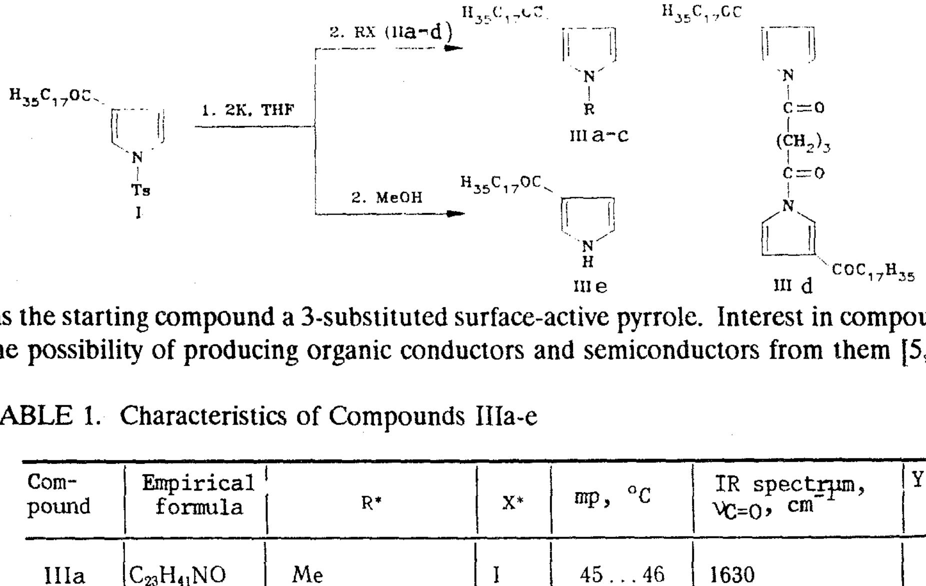
A method has been proposed for the detosylation of 3-substituted pyrroles by potassium in tetrahydrofuran with a simultaneous activation of the 1-position for the subsequent alkylation or acylation of the pyrrole-potassium derivative.

The electrophilic substitution reactions in pyrrole proceed at the 2-position [1]. To obtain 3-substituted derivatives it was necessary to preliminarily introduce a benzenesulfonyl [2] or tosyl [3] group into the 1-position. The tosyl group in pyrrole can be removed by alkaline hydrolysis in an aqueous-alcoholic or an aqueous-dioxane medium [3] and also by reduction with sodium borohydride [4].

The method we propose for the removal of the tosyl group is distinguished in that it makes possible the simultaneous activation of the 1-position of pyrrole for the electrophilic attack for the subsequent preparation of N-substituted derivatives. The method consists in the reduction of N-tosyl-3-acylpyrrole I by two equivalents of potassium in tetrahydrofuran at room temperature in an argon atmosphere, followed by alkylation or acylation of the pyrrole-potassium derivative.



We chose as the starting compound a 3-substituted surface-active pyrrole. Interest in compounds in this series was prompted by the possibility of producing organic conductors and semiconductors from them [5, 6].

TABLE 1. Characteristics of Compounds IIIa-e

Compound	Empirical formula	R*	X*	mp, °C	IR spectrum, $\nu_{C=O}$, cm^{-1}	Yield, %
IIIa	$C_{23}H_{41}NO$	Me	I	45...46	1630	92
IIIb	$C_{25}H_{41}NO$	$CH_2-C{\equiv}CH$	Br	58...59	1680	86
IIIc	$C_{24}H_{41}NO_2$	MeCO	Cl	79...80	1660, 1710	86
IIId	$C_{49}H_{82}N_2O_4$	$CO(CH_2)_3CO$	Cl	190	1660, 1710, 1720	89
IIIe	$C_{22}H_{39}NO$			74...75	1630**	90

*Correspond to the meanings of R and X for compounds IIa-d.

**ν_{N-H} 3290 cm^{-1}.

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TABLE 2. PMR Spectra of Compounds IIIa-e in $CDCl_3$

Compound	δ, ppm					J, Hz
	1-R	2-H (1H)	3-R (M)	4-H	5-H	
IIIa	3,68 (3H, s)	7,22 (d.d)	2,69 (2H, $COCH_2$); 1,25 (32H, $C_{16}H_{32}$); 0,87 (3H, CH_3)	6,57 (1H, d*)	6,57 (1H, d*)	$J_{2,4}=J_{2,5}==1,83$
IIIb	2,50 (1H, t); 4,69 (2H, d)	7,40 (d.d)	2,71 (2H, $COCH_2$); 1,25 (32H, $C_{16}H_{32}$); 0,88 (3H, CH_3)	6,62 (1H, d.d)	6,75 (1H, d.d)	$J_{2,4}=1,71$; $J_{2,5}=1,96$; $J_{4,5}=3,18$; $J_{CHCH_2}=2,44$
IIIc	2,59 (3H, s)	7,87 (d.d)	2,76 (2H, $COCH_2$); 1,25 (32H, $C_{16}H_{32}$); 0,88 (3H, CH_3)	6,70 (1H, d.d)	7,34 (1H, d.d)	$J_{2,4}=1,40$; $J_{2,5}=1,95$; $J_{4,5}=3,66$
IIId	3,09 (2H, t, $COCH_2$); 2,30 (2H, m)	7,91 (d.d)	2,76 (2H, $COCH_2$); 1,25 (32H, $C_{16}H_{32}$); 0,88 (3H, CH_3)	6,72 (1H, d.d)	7,31 (1H, d.d)	$J_{2,4}=1,74$; $J_{2,5}=1,95$; $J_{CH_2CH_2}=6,71$
IIIe	8,54 (1H, br.s)	7,43 (m)	2,75 (2H, $COCH_2$); 1,25 (32H, $C_{16}H_{32}$); 0,88 (3H, CH_3)	6,78 (1H, m)	6,67 (1H, m)	$J_{2,4}=1,10$; $J_{2,5}=1,46$; $J_{4,5}=2,92$

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*Overlapping signals.

Using one equivalent of methyl iodide, propargyl bromide, or acetyl chloride as alkylating or acylating agent IIa-d, 1-methyl-, 1-(3′-propyn-1′-yl), and 1-acetyl-3-octadecanoylpyrroles (IIIa-c) were obtained, while with 0.5 equivalent of glutaroyl dichloride 1,5-dioxo-1,5-bis(3-octadecanoylpyrrol-1-yl)pentane (IIId) was obtained (Tables 1 and 2).

The intermediate pyrrole-potassium derivative can be converted into N-substituted derivatives or pyrrole IIIe by treatment with methanol.

The pyrrole derivatives obtained were characterized by PMR and IR spectra and elemental analysis data.

EXPERIMENTAL

The PMR spectra were obtained on a Bruker WP-200 SY spectrometer (in $CDCl_3$), using TMS as internal standard. The IR spectra were run on a UR-20 spectrophotometer (in mineral oil), scanning rate 160, spectral width of the slit 4 cm^{-1}.

The data of the elemental analyses for C, H, and N correspond to the calculated values.

1-Tosyl-octadecanoylpyrrole was obtained according to [7].

General Method for the Synthesis of Compounds IIIa-e. A 0.39 g portion (0.1 mole) of potassium was added at 20°C to a solution of 0.296 g (0.5 mmole) of compound I in 5 ml of THF, and the mixture was stirred for about 1 h in an argon atmosphere up to dissolution. To the solution obtained, 0.5 mmole of IIa-c,e was added (in the case of IId — 0.25 mmole) in 3 ml of THF, and stirring was continued for a further 1 h. The mixture was filtered, the solvent was evaporated under vacuum, and the residue was recrystallized from methanol to yield compounds IIIa-e.

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