SYNTHESIS OF CORONANDS CONTAINING SULFONAMIDE CORES IN THE MACROCYCLE

V. M. Dziomko, I. S. Markovich,
O. A. Tsirkina, Yu. S. Ryabokobylko,
and M. P. Filatova

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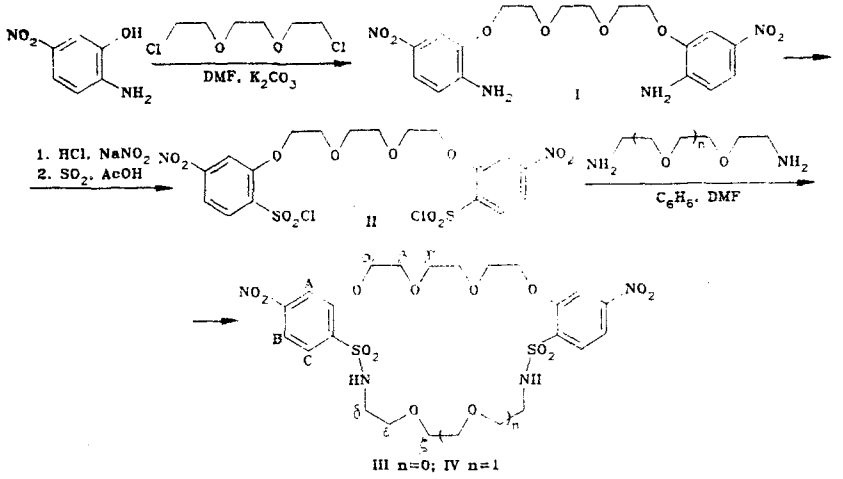
Sulfonamide coronands containing sulfonamide cores in the macrocycle are prepared by cyclization of 1,10-bis(5-nitro-2-chlorosulfonylphenyl)-1,4,7,10-tetraoxadecane with α,ω-diaminooligooxaalkanes.

One of the possible routes for increasing the stability of crown-ether complexes could be to build proton-ionizing groups into the macrocycle which will form a stable tight ion pair with the metal cation upon deprotonation. This pair would protect the periphery of the macrocycle. The first coronands of this type were based on the crown-cycloformazanes [1, 2] and some of these have found application in analytical chemistry [3]. Later the 1,2,4-4H-triazole [4] and 1,4-dihydro-1H-pyridine-4-one [5-9] groups were included in the macrocycle.

It would be interesting to use proton-ionizing sulfonamide groups [10, 11]. Coronands with these groups were synthesized by the following scheme:



Reaction of 5-nitro-2-aminophenol with 1,8-dichloro-3,6-dioxaoctane [12] gives the bisamine I. The bissulfochloride II is synthesized from I under Meerwein conditions [13]. Its cyclization with α,ω-diaminooligooxaalkanes led to formation of sulfonamide coronands III and IV.

The aromatic part of the PMR spectra of compounds I-IV in DMSO-D_6 corresponds to an ABC system of protons. Upon going from I to II, a shift of aromatic proton signals to weak field is observed connected to exchange of the electron-donor substituent NH_2 for the electron-accepting SO_2Cl ($\Delta\sigma$ 0.18-1.46 ppm). With further transition from II to coronands III and IV, a small shift to strong field of the A- and C-proton signals is observed related to the introduction of the NH group. The multiplicity of the signals and the SSCC of the protons does not change in this case (J_{AB} = 2 Hz, J_{BC} = 9 Hz) (Table 1).

Introduction of a sulfonyl group into the ring affects the aliphatic protons. The maximal electron-accepting effect is experienced by the α-CH_2 group ($\Delta\sigma$ = 0.35 ppm); for the β- and γ-CH_2 groups $\Delta\sigma$ is equal to 0.24 and 0.19 ppm, respectively. The multiplicity of

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TABLE 1. PMR Spectrum of Compounds I-IV in DMSO-D_6

Compound	Chemical shift, ppm (SSCC, HZ)									
	H_{aliph}						H_{arom}			
	α, m (4H)	β, m (4H)	γ, c (4H)	δ (4H)	ε (4H)	ζ (4H)	A,d (2H, J_{AB})	B,dd (2H, J_{BC}, J_{AB})	C,d (2H, J_{BC})	$\frac{NH_2}{NH}$
I	4,18	3,78	3,62	—	—	—	7,62 (2)	7,73 (8,8, 2,4)	6,69 (8,8)	6,26 s / —
II	4,53	4,02	3,81	—	—	—	8,10 (2)	7,91 (9; 2)	8,15 (9)	— / —
III	4,54	3,97	3,81	3,12 m	3,36 m	—	7,94 (2)	7,91 (9; 2)	7,98 (9)	— / 6,50 s
IV	4,47	4,08	3,92	3,13 m	3,56 m	3,56 s	7,98 (2)	7,93 (9; 2)	8,14 (9)	— / 6,18

signals corresponds to an AA'BB' system of α- and β-protons, the γ-protons are a singlet. The spectrum of the second ether chain of III and IV, which is observed at stronger field are analogous: the signals of the δ- and ε-protons are multiplets, the ζ-protons are a singlet. The electron-donor effect of the NH group is maximal for the δ-protons (3.12 and 3.13 ppm) and decreases for the ε- and ζ-protons (3.36 and 3.56 ppm).

The signal of the NH protons is a broadened singlet ($\nu_{1/2} \geqslant 20$ Hz) at 6.2-6.5 ppm.

EXPERIMENTAL

PMR spectra were measured on a Varian XL-100-12 (100 MHz) spectrometer at 0.02 M concentration in DMSO-D_6 with TMS internal standard. Elemental analysis of I, II-IV for C, H, N, and S corresponded with the calculated values.

1,10-Bis(5-nitro-2-aminophenyl)-1,4,7,10-tetraoxadecane (I, $C_{18}H_{22}N_4O_8$). A mixture of 15.4 g (0.1 mole) 5-nitro-2-aminophenol and 18.6 g (0.13 mole) potassium carbonate in 100 ml DMF was heated to 40°C and 9.35 g (0.05 mole) 1,8-dichloro-3,6-dioxaoctane was added dropwise. The reaction mixture was stirred for 6 h at 140°C, cooled, and poured into 1 liter of water. The precipitate which formed was filtered. After reprecipitation from a hot DMF solution by water, 18.8 g (45%) I was obtained, mp 152-153°C.

1,10-Bis(5-nitro-2-chlorosulfonylphenyl)-1,4,7,10-tetraoxadecane (II, $C_{18}H_{18}N_2O_{12}S_2Cl_2$). Compound I (5.3 g, 0.0125 mole) was dissolved in 150 ml conc. HCl, the mixture was cooled to 5°C and a solution of 2.8 g (0.04 mole) sodium nitrite in 10 ml water was added dropwise. The solution obtained was added to a mixture of 60 ml CH_3COOH, saturated with 39 g SO_2, and a solution of 0.5 g (0.03 mole) $CuCl_2$ in 5 ml water. The reaction mixture was left overnight. The tarry precipitate which formed was dissolved in chloroform and washed with water, 5% $NaHCO_3$, and water again. The chloroform layer was dried with $CaCl_2$ and evaporated. The oily residue was dried for 4 h at 70°C and washed with ethyl ether. Yield 4.6 g (62%) II, mp 73-74°C.

Sulfonamide Coronands III and IV. To a mixture of 8 ml DMF and 20 ml benzene heated to 50°C were added simultaneously and dropwise over 45 min a solution of 0.016 mole II in 110 ml benzene and a solution of 0.016 mole of the corresponding α,ω-diaminooligooxaalkane in 80 ml benzene. The mixture was heated and stirred for 15 h at 70°C. The solvent was removed under reduced pressure and 200 ml methanol were added to the residue. The precipitated coronand was filtered. Yield 1.97 g (20%) III, $C_{22}H_{28}N_4O_{13}S_2$, mp 241-242°C. Yield 0.83 g (20%) coronand IV, $C_{24}H_{32}N_4O_{14}S_2$, mp 190-191°C.

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SYNTHESIS OF 1,3,4-THIAZOLE DERIVATIVES BY THE REACTION OF THIOBENZHYDRAZIDE WITH SOME ACYLACETYLENES

T. E. Glotova, A. S. Nakhmanovich, and M. V. Sigalov

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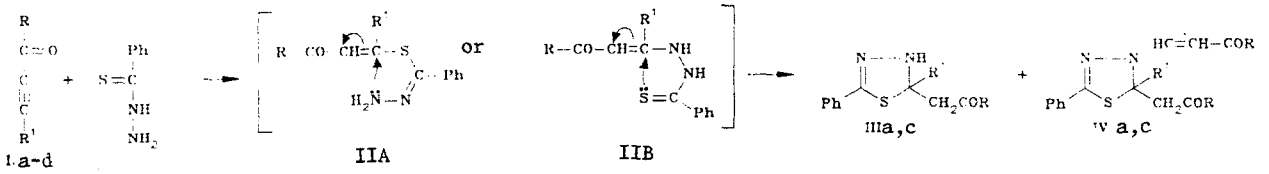
2-Acylmethyl-5-phenyl- and 3-acylvinyl-2-acylmethyl-5-phenyl-1,3,4-thiadiazol-4-ines were obtained by the reaction of terminal α-acetylenic ketones with thiobenzhydrazide. Substituted acetylenic ketones react with thiobenzhydrazide in alcohol to give N,S-bis(acylvinyl)thiobenzhydrazides.

The reaction of aromatic thiohydrazides with dimethyl acetylenedicarboxylate and methyl propylate by heating in anhydrous methanol leads to the formation of substituted 1,3,4-thiadiazoles [1]. 1,3,4-Thiadiazole derivatives have a number of practically valuable properties and can be used as chemical agents for the protection of plants [2, 3], antibacterial agents [4], and antioxidants for oils [5].

We have investigated the reaction of acylacetylenes Ia-d with thiobenzhydrazide.

Terminal α-acetylenic ketones Ia,c in methanol react with thiobenzhydrazide at 20°C and an equimolar reagent ratio to give 3-acylvinyl-2-acylmethyl-5-phenyl-1,3,4-thiadiazol-4-ines IVa,c in 80% yields (based on the ketone) and a small amount (8-11%) of 2-acylmethyl-5-phenyl-1,3,4-thiadiazol-4-ines IIIa, c. A change in the ketone—thiobenzhydrazide ratio (2:1) has virtually no effect on the yields of IVa, c.



a R=Ph, R¹=H; b R=R¹=Ph; c R=α-C₄H₃S, R¹=H; d R=α-C₄H₃S, R¹=Ph

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