Small Angle X-ray Diffraction Study of the Liquid Crystalline Homologous Series 4,4'-di-n-alkyl-azoxy-benzenes

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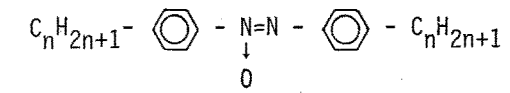
Although the liquid crystalline concept of biological membranes is widely accepted, the relationship between molecular structure of their constituents (e.g. alkyl chain length of lipids, type of their polar groups) and the mesomorphic properties remains to a great extend unresolved.
We investigated the phase transitions and order parameters of a thermotropic liquid crystalline system. This system, the homologous series of 4,4'-di-n-alkyl-azoxy-benzenes



(alkyl chain length from n = 6 to n = 10)

exhibits the following phase transitions (^{o}C) and X-ray long periods in the smectic phase (nm):

n	Cr		S		N		I	d_S(nm)	Δd_S(nm)
6	o			25.9	o	53.4	o		
7	o	33.9	o	53.8	o	70.6	o	2.78	0.16
8	o	39.0	o	64.4	o	66.7	o	2.94	0.28
9	o	44,2	o			75.7	o	3.22	0.16
10	o	49,6	o			76.0	o	3.38	

X-ray diffraction patters from unoriented samples are recorded using a Kratky-Compact-Camera and a position sensitive proportional counter (Fa.M. Braun, Munich). A few reflections are registered in the crystalline state (Cr), one single reflection is measured in the smectic phase (S); no discrete inner reflections occur in the nematic (N) and the isotropic phase (I). The distances between successive layers in the smectic phase (d_S) and the increments of these distances with increasing alkyl chain length (Δd_S) are also given in the table. Obviously, these values show an "odd-even" effect with respect to the number of carbon atoms of the alkyl chain: d_S increases by 0.16 nm proceeding from C_7 to C_8 and from C_9 to C_{10}; whereas d_S is 0.28 going from C_8 to C_9.
Length of the molecule, smectic layer distance and the increments of the layer distances within the homologous series are used to assign the type of smectic phase.
In addition, the integrated intensities of the Bragg reflections versus temperature in the smectic phase, strictly correlated to the translational order parameter, served to test the molecular theory for smectic phases of W.L. McMillan.

1.W.L. McMillan, Phys. Rev. A4, 1238-46 (1971)