

The Thermal Properties of Liquid Crystals exhibiting a Chiral Smectic C Phase

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The preparation and thermal properties of two series of compounds exhibiting a chiral smectic C phase, *i.e.*, (*S*)-2-methylbutyl 4-(4-alkoxyphenoxy)methylbenzoates and (*S*)-4-(2-methylbutoxy)phenyl 4-(4-alkoxyphenoxy)methylbenzoates are reported.

There has been intense interest in the preparation of liquid crystals that exhibit a chiral smectic C (SC_C^*) phase for devices employing a ferroelectric mode. The low melting SC_C^* materials hitherto reported consist of two aromatic rings, *i.e.*, biphenyl,¹ phenyl benzoate,¹ or benzylideneaniline.² Compounds containing a pyrimidine rings show similar properties. In this paper, we describe the thermal properties of two new homologous series incorporating a $-OCH_2-$ linkage.

4-(4-Alkoxyphenoxy)methylbenzoic acids were obtained by the reactions of 4-alkoxyphenols and methyl 4-bromomethylbenzoate. (*S*)-4-(2-Methylbutoxy)phenol was prepared by the usual method and esterifications were carried out using dicyclohexylcarbodi-imide. The benzoic acids (carbon number 3—9) show nematic and smectic C phases; the thermal properties are summarized in Table 1.

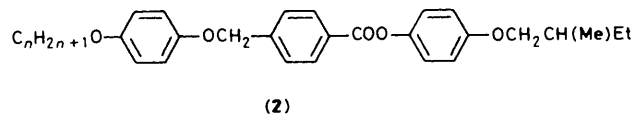
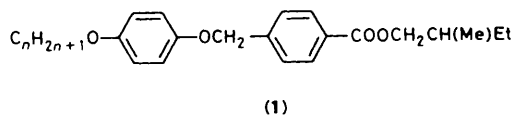
Both series have the fundamental C- SC_C^* - S_A -I type mesomorphic sequence, and only the propoxy homologue of (2) displays a cholesteric phase.

The $-OCH_2-$ linkage has been used in nematic materials. However, the $-OCH_2-$ linkage is less important than the ester and azomethine ones, because it reduces the nematic-isotropic transition temperatures, while the melting points are increased.⁵ In fact, the cholesteric stability for series (2) is lower than those of the other linkages. However, the thermal

Table 1. Transition temperatures (°C) for series (1) and (2).^a

Compound	<i>n</i>	C	SC_C^*	S_A	Ch	I	
(1)	3	• 70.8	—	—	—	•	
	4	• 63.5	—	—	—	•	
	5	• 41.2	—	(37.5)	—	•	
	6	• 43.6	(- 31.3	• 41.3)	—	•	
	7	• 39.0	(- 35.3	• 40.1)	—	•	
	8 ^b	• 45.0	(- 38.0	• 42.7)	—	•	
	9	• 44.8	(- 34.5	• 44.4)	—	•	
	(2)	3	• 122.8	—	• 129.0	• 131.2	•
		4	• 115.4	—	• 137.8	—	•
5		• 108.8	(- 101.0)	• 135.0	—	•	
6		• 104.4	• 108.3	• 140.2	—	•	
7 ^c		• 102.0	• 119.8	• 135.9	—	•	
8		• 102.7	• 125.1	• 138.8	—	•	
9		• 104.5	• 122.8	• 139.9	—	•	

^a C, SC_C^* , S_A , Ch, and I represent crystal, smectic C, smectic A, cholesteric, and isotropic phases, respectively. Parentheses indicate monotropic transitions. ^b In ref. 4, the transition temperature (m.p. 45.8°C, non-mesogenic) for only the octyloxy homologue has been reported. ^c This compound underwent a smectic SC_C^* transition at 115°C.



stabilities of the S_{C}^* and S_{A} phases for series (1) are quite similar to those of the biphenyl,¹ phenyl benzoate,¹ and benzylideneaniline compounds.⁶

The replacement of the $-\text{OCH}_2-$ linkage in series (1), by a $-\text{NHCH}_2-$ one results in disappearance of the mesophases, while the melting points are similar to those of series (1).

The spontaneous polarization for the heptyloxy homologue of series (1) was *ca.* 5 nC/cm² at 30 °C. This is also analogous to those of the corresponding biphenyls and phenyl benzoate compounds.⁶

In conclusion, the homologous series (1) might be useful materials for devices employing a ferroelectric mode, and the $-\text{OCH}_2-$ linkage (as well as the ester and azomethine ones) is desirable for the smectic materials.

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References

- 1 J. W. Goodby and T. M. Leslie, 'Liquid Crystals and Ordered Fluids,' eds. A. C. Griffin and J. F. Johnson, Plenum Press, New York, 1984, vol. 4, pp. 1ff.
- 2 G. W. Gray and K. J. Harisson, *Mol. Cryst. Liq. Cryst.*, 1971, **13**, 37; R. B. Meyer, L. Liebert, L. Strzelecki, and P. Keller, *J. Phys. Lett.*, 1975, **36**, 69.
- 3 H. Zschke, *J. Prakt. Chem.*, 1975, **317**, 617.
- 4 T. Inukai, K. Furukawa, K. Terashima, S. Saito, M. Isogao, S. Hattori, K. Iwasaki, T. Kitamura, and A. Mukoh, *Jpn Kokai Tokkyo Koho*, 60-149547.
- 5 G. W. Gray and D. G. McDonnell, *Mol. Cryst. Liq. Cryst.*, 1979, **53**, 147.
- 6 T. Inukai, K. Furukawa, K. Terashima, S. Saitoh, S. Hattori, M. Isogai, K. Iwasaki, T. Kitamura, and A. Mukoh, unpublished results.