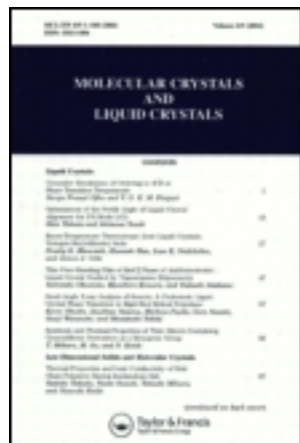




Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/gmcl16>

trans, Trans-Cyclohexyl Cyclohexanoates a New Class of Aliphatic Liquid Crystals

Maged A. Osman^a & Laszlo Revesz^a

^a Brown Boveri Research Center, 5405, Baden-Dattwil, Switzerland
Version of record first published: 20 Apr 2011.

To cite this article: Maged A. Osman & Laszlo Revesz (1979): trans, Trans-Cyclohexyl Cyclohexanoates a New Class of Aliphatic Liquid Crystals, *Molecular Crystals and Liquid Crystals*, 56:4, 105-109

To link to this article: <http://dx.doi.org/10.1080/01406567908071976>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.tandfonline.com/page/terms-and-conditions>

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae, and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

trans, trans-CYCLOHEXYL CYCLOHEXANOATES
A NEW CLASS OF ALIPHATIC LIQUID CRYSTALS

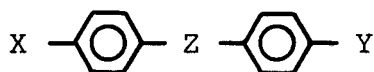
MAGED A. OSMAN AND LASZLO REVESZ

Brown Boveri Research Center,
 5405 Baden-Dättwil, Switzerland

Submitted for publication: 9 September 1979

ABSTRACT: Dialkyl-, alkyl cyano- and alkyl cyclohexyl-cyclohexyl cyclohexanoates were synthesized. The lower homologs show nematic phases while the higher ones show nematic and/or smectic phases. Long alkyl chains on the acid side favor the nematic phase.

Nematic phases with small optical anisotropy are required for different applications, eg., twisted nematic¹ and guest-host² displays. The classical structure of nematogens (I) containing aromatic rings leads to Δn values between 0.14 and 0.27 depending on the substituents X, Y and Z.



I

Replacement of one aromatic moiety by a cyclohexyl ring in structure (I) reduces Δn by about 0.08 as can be seen from a comparison between

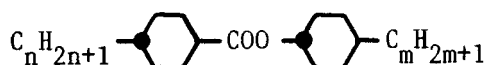
the values obtained for the alkyl cyano biphenyls³ and the corresponding phenyl cyclohexanes (PCH)^{4,5}. Going further to the completely aliphatic bicyclohexane system (CCH)⁶, Δn is further lowered and values of 0.06 were measured⁷. However, the CCH's are mainly smectic with short nematic ranges. Substituting the cyano group by an alkyl group also decreases Δn as well as $\Delta \epsilon$ and the viscosity as can be seen from a comparison between the cyano phenyl alkyl benzoates⁸ and the alkyl alkoxy derivatives⁹.

It is to be expected that a dialkyl bicyclohexane will show the lowest possible optical anisotropy. However, the introduction of another alkyl group in the bicyclohexane system will enhance the smectic tendency and no nematics are to be expected. Therefore, we decided to try this substitution in a bicyclohexyl system which is interrupted by a carboxyl bridge, namely the cyclohexyl cyclohexanoates in the hope of obtaining nematic phases.

A series of dialkyl cyclohexyl cyclohexanoates was synthesized where the alkyl chains contain an odd number of carbon atoms in order to obtain high clearing points. Table 1 shows their transition temperatures. The members of this series generally show low melting temperatures. The lower homologs are monotropic nematic. The clearing points increased with growing alkyl chain length but smectic phases appeared in addition to, or instead of the nematic phase. Only one smectic phase having a mosaic texture and high viscosity was observed. The effect of the alkyl chain length on the transition temperatures in the dialkyl cyclo-

hexyl cyclohexanoates is very similar to that in the dialkyl benzylidene anilines¹⁰ except for the fact that in this case long alkyl chains on the acid side favor the formation of nematic phases.

TABLE 1 Transition Temperatures ($^{\circ}\text{C}$) in



n	m	k	S	N	I
1	1	•	35.0		•
1	3	•	19.9	• (-18.2)	•
1	5	•	17.8 •	20.0	•
2	3	•	14.0 •	(-14.2) •	(5.5) •
3	1	•	21.0		•
3	2	•	9.1	• (-2.6)	•
3	3	•	22.8	•	36.6 •
4	1	•	13.1	• (-15.0)	•
5	1	•	18.3	•	(3.3) •
5	3	•	25.1 •	36.8 •	52.1 •

It is to be expected that substitution of one of the alkyl groups by a cyano group would enhance the formation of a nematic phase. Unfortunately, this group increased the melting point of (5, CN) and its melt could not be supercooled enough to determine its clearing point (Table 2). However, this was estimated by the extrapolation method from mixtures of this compound with PCH5.

TABLE 2 Transition Temperatures ($^{\circ}\text{C}$) in

X	Y	K	S	N	I
C_5H_{11}	CN	• 59.8		(16 [*])	•
C_5H_{11}	CH_3	• 150.7	• (150.2)	• 155.9	•

* by extrapolation

Substitution of the alkyl chain on the acid side by an alkyl cyclohexyl moiety raised the melting as well as the clearing point. The purity of the products was $\geq 99.8\%$ as determined by GLC. The transition temperatures were determined using a modified Mettler FP52 hot stage¹⁰.

REFERENCES

- 1) J. Nehring, III. Liquid Crystal Conference of Socialist Countries 1979.
- 2) T.J. Scheffer and J. Nehring, IBM Symposium on Liquid Crystal Devices 1979.
- 3) British Drug House, England, Data sheets on biphenyls.
- 4) R. Eidenschink, D. Erdmann, J. Krause and L. Pohl, Angew. Chem. Intern. Ed. **16**, 100 (1977).
- 5) L. Pohl, R. Eidenschink, J. Krause and D. Erdmann, Phys. Lett. **60A**, 421 (1977).

- 6) R. Eidenschink, D. Erdmann, J. Krause and L. Pohl, Angew. Chem. Intern. Ed. 17, 133 (1978).
- 7) L. Pohl, R. Eidenschink, J. Krause and G. Weber, Phys. Lett. 65A, 169 (1978).
- 8) M. Schadt and F. Müller, Revue de Phys. Appl. 14, 265 (1979).
- 9) E. Merck, W. Germany, Data sheet on Licristal 1052.
- 10) J. Nehring and M.A. Osman, Z. Naturforsch. 31a, 786 (1976).