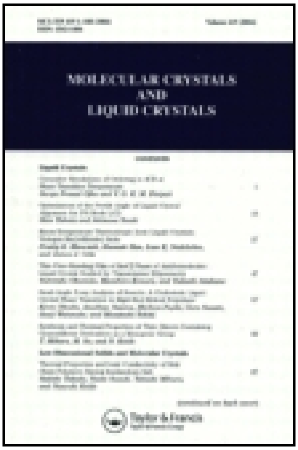


Molecular Crystals and Liquid Crystals Incorporating Nonlinear Optics
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl17

Influence of Achiral So Host on the Values of Spontaneous Polarization and Rotational Viscosity of Ferroelectric Mixtures

M. Buivydas [a] , P. Adoménas [a] , O. Adoméniené [a] & A. Beganskiené [a]

[a] Vilnius University, Universiteto 5, Vilnius, Lithuania

Version of record first published: 22 Sep 2006.

Mol. Cryst. Liq. Cryst. 1990, Vol. 191, pp. 407–411
Reprints available directly from the publisher
Photocopying permitted by license only

Printed in the United States of America

INFLUENCE OF ACHIRAL Sc HOST ON THE VALUES OF SPONTANEOUS POLARIZATION AND ROTATIONAL VISCOSITY OF FERROELECTRIC MIXTURES

M.BUIVYDAS,P.ADOMĖNAS,O.ADOMĖNIENĖ,A.BEGANSKIENĖ
Vilnius University,Lithuania,Vilnius Universiteto 5

Abstract Spontaneous polarization and rotational viscosity of Sc guest host mixtures was measured. Three different hosts were compared.

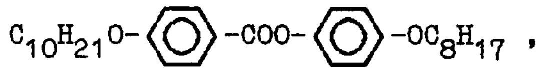
INTRODUCTION

Since the discovering ferroelectric liquid crystals many interesting applications were found. An optimization of many parameters such as the tilt angle, the pitch, the spontaneous polarization and the rotational viscosity is necessary to make the mixtures more applicable. The most interesting now are the guest-host ferroelectric liquid crystal mixtures. In present work we examine the achiral hősts of three different types, in order to establish regularities in the chiral guest-achiral host interactions and to find the most acceptable hosts for practical use.

EXPERIMENTAL

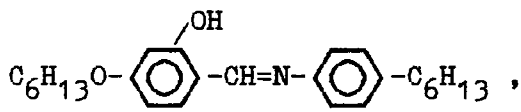
Substances

We used the following achiral compounds as the hosts:



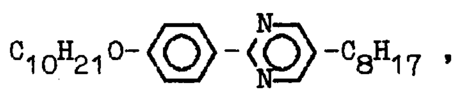
[1]

Cr-71,0°-S_C-88,5°-S_A-87,5°-N-91,5°-I;



[2]

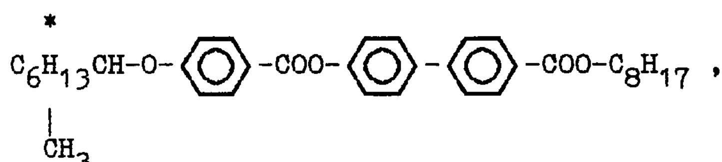
Cr-42,5°-S_C-80,5°-N-94,0°-I;



[3]

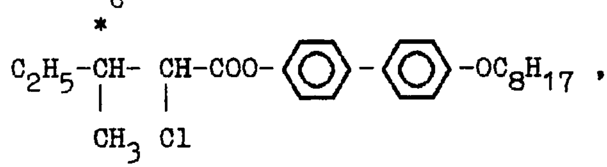
Cr-34,5°-S_C-61,5°-S_A-67,2°-N-70,5°-I;

The following chiral compounds were used as the dopants:



[4]

Cr-43,5°-S_c-65,2°-N-72,0°-I;



[5]

Cr-48,$^{\circ}$-S_H-55,0°-S_C-64,0°-S_A-65,5°-*I*.

Physical measurements

For the polarization and viscosity measurements, we used the cells formed from transparent electrodes, coated by polyvinylbuthyral and phenylformaldehyde resin mixture and rubbed (about 7 μm thick, an electrode area about 3 cm^2). The cells were filled by capillary suction and were kept under constant temperature during the measurements. The cell was excited by rectangularly shaped voltage and rotational viscosity was estimated from electrooptical response and polarization reversal kinetics.

RESULTS AND DISCUSSION

In present work the temperature dependencies of spontaneous polarization and rotational viscosity were measured. The rotational viscosity was estimated by two techniques - electrooptical one[1] and from polarization reversal kinetics after an excitation of the cell by rectangularly shaped voltage. Rotational viscosity was calculated from formulas:

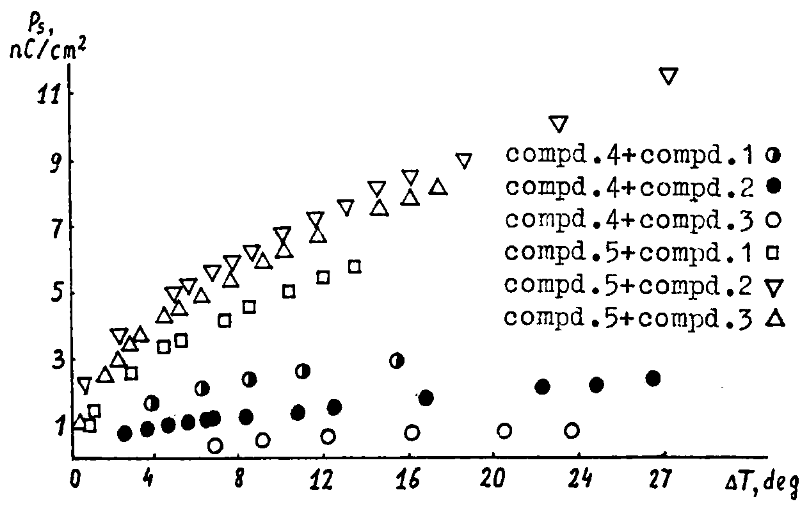


FIGURE 1 Spontaneous polarization dependence upon reduced temperature.All the mixtures consist of 10% of chiral compound (4,5) and 90% of non-chiral compound (1,2,3).

$$I_{max} = AP_s^2E \,/\, \gamma_\phi \quad \text{and} \tag{1}$$

$$\Delta t_{0.5} = 2\ (\gamma_\phi / P_sE)\ \ln(1/\ \tan[\pi/8])\ , \tag{2}$$

where $\Delta t_{0.5}$ is the width at half heigth of the polarization reversal current, I_{max} - its full heigth, A is the area of electrode ,P_s,E and γ_ϕ - spontaneous polarization,electric field and rotational viscosity correspondingly.Both these techniques give the same results (see Fig.2). Spontaneous polarization versus reduced temperature ($\Delta T=T-T_c$) is plotted in Fig. 1.

If $\ln\gamma_\phi$ versus 1/T is plotted one can see that temperature dependence of the rotational viscosity obeys the formula[2]

$$\gamma_\phi = \gamma_\phi^o \exp(\Delta E/kT)\ . \tag{3}$$

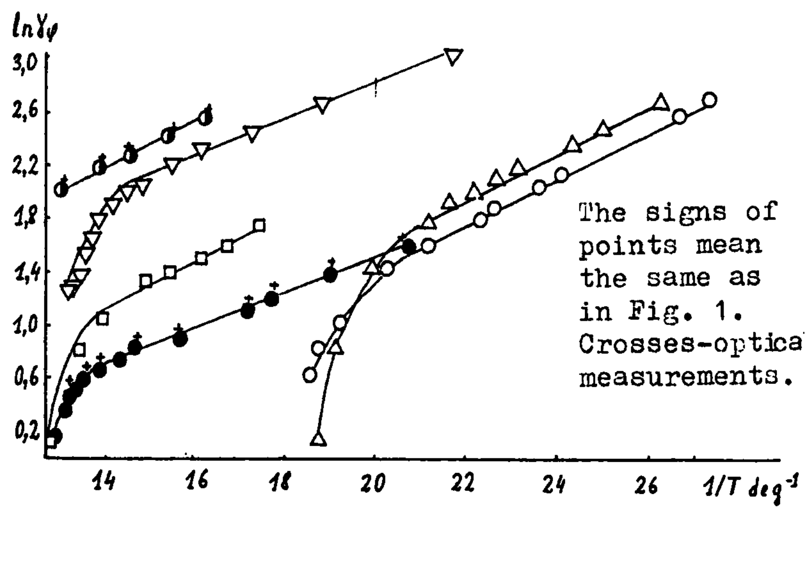


FIGURE 2 Rotational viscosity logarithmic plot versus 1/T.

Of course, it is true only for small dopant concentrations and temperatures remoted from the S_C- S_A transition point.Deviation from this rule is well expressed near the transition point.

As one can see from Fig. 2 ΔE depends only upon the host and can characterize it; and γ_ϕ^o depends on the guest-host interaction.It is well known that the chiral guests create some rotational hindrance. The stronger the hindrance, the larger spontaneous polarization of this mixture. Parallel to this the rotational viscosity increases. However, when compounds [1] and [4] are mixed together a larger viscosity is observed than in the case of the mixture of [1] and [5]. It's possible to compare three different hosts. The best ones are the salicydenanilines [2] andphenylpyrimidines [3], their ΔE values being about 1.5 times smaller than phenylbenzoates [1]. However, the substance [2] exhibits rather large viscosity γ_ϕ^o and aproximately equal polarization to that of the substance [3], when a dopant with a large dipole moment is used. Taking into account that the salicydenanilines [2] are yellow and don't form S_A phase, which is necessary for the alignment of FLC mixture, there are some limitations for practical uses of this material.

REFERENCES

1. Pozhidayev E.P., Osipov M.A., Chigrinov V.G., Baikalov V.A., Blinov L.M., Beresnev L.A., Zh E T F, 94, 125 (1988).
2. Chandani A.D.L., Ouchi Y., Takezoe H., Fukuda A., Japan. J. of Appl. Phys., 27, L276 (1988).