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FINAL TECHNICAL REPORT

TO

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

Title: An Investigation of the Ordering of Molecules in the Anisotropic Liquid Phase of Liquid Crystals

GRANT No. AF AFOSR 605-64

Principal Investigator: Edward F. Carr
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The most significant aspect of this project has been the study of molecular alignment in liquid crystals owing to electric fields. Results have shown that magnetic fields can be replaced by electric fields for producing molecular alignment in some experiments involving liquid crystals. Magnetic fields are expensive to produce and the equipment is bulky; whereas, equipment for producing high electric fields is much less bulky and costly. In many liquid crystals the long axes of the molecules often prefer a direction perpendicular to that predicted from theoretical considerations when an external electric field is applied. The most popular explanation has associated a permanent electric dipole moment with a cluster of molecules. Results from this project have shown that this model is very doubtful, and a new theory has been proposed which involves the conductivity anisotropy. Although new results with other liquid crystals are needed to further check the proposed model, the theory seems to explain very well the results that are available.

Much of the early work involved the dielectric properties of liquid crystals at UHF and microwave frequencies. This work has been extended by a group at the University of Freiburg, and they have found that the results on many new materials are consistent with the results which were reported from this project.

The experimental methods which were involved were primarily microwave techniques, but this past year it was found that nuclear magnetic resonance techniques can also be a valuable method. The last article which was submitted for publication showed the effects of electric fields on the NMR spectra of liquid crystals.

The following list of publications resulted from this project:

"Dielectric Loss in the Liquid Crystal p-Azoxyanisole", E. F. Carr, Journal of Chemical Phsyics, 37, (104-106), (1962).

"Influence of Electric and Magnetic Fields on the Dielectric Constant and Loss of the Liquid Crystal Anisaldazine", E. F. Carr, Journal Chem. Phys., 38, 1936-1940 (1963).

"Influence of an Electric Field on the Dielectric Loss of the Liquid Crystal p-Azoxyanisole", E. F. Carr, J. Chem. Phys., 39, 1979-1983 (1963).

"Influence of Electric and Magnetic Fields on the Dielectric Constant of a Liquid Crystal with a Positive Dielectric Anisotrophy", E. F. Carr, J. Chem. Phys. 42, 738-742 (1965).

Invited Paper - - "Ordering in Liquid Crystals due to Electric Fields", E. F. Carr, presented at symposium entitled "Ordered Fluids and Liquid Crystals", ACS Meeting Atlantic City, New Jersey, September 1965.

"Influence of Electric and Magnetic Fields on the Molecular Alignment in the Liquid Crystal Anisal-p-aminoazobenzene, E. F. Carr, J. Chem. Phys., 43, 3905-3910 (1965).

"Ordering in Liquid Crystals Owing to Electric and Magnetic Fields", E. F. Carr, Adv. Chem. Series, 63, 76-88 (1967).

"Influence of Electric Fields on the Molecular Alignment in the Liquid Crystal p-Azoxyanisole", R. P. Twitchell and E. F. Carr, J. Chem. Phys., 46, 2765-2769 (1967).

"Influence of Electric Fields on the NMR Spectra of the Liquid Crystal p-(Anisalamino)-phenyl Acetate", E. F. Carr, E. A. Hoar, and W. T. MacDonald. Submitted to the Journal of Chemical Physics for publication as a note.

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13. ABSTRACT

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