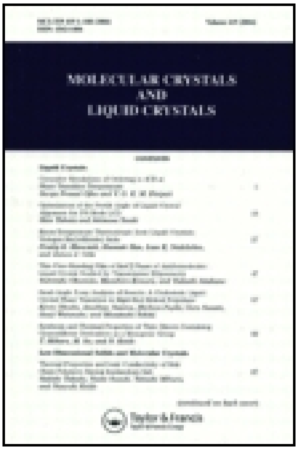

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Determination of the Voltaic Potential Difference ΔV - A New Method to Characterize Liquid Crystal Layers on Solid Substrates

Arno Seeboth [a] & Günter Kretzschmar [a]
[a] Zentralinstitut für Organische Chemie, AdW DDR, Berlin, DDR
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DETERMINATION OF THE VOLTAIC POTENTIAL DIFFERENCE ΔV - A NEW METHOD TO CHARACTERIZE LIQUID CRYSTAL LAYERS ON SOLID SUBSTRATES

ARNO SEEBOTH AND GÜNTER KRETZSCHMAR
Zentralinstitut für Organische Chemie, AdW DDR,
Berlin, DDR

Abstract The determination of the voltaic potential difference is a suitable method to characterize the phase transition in a liquid crystal component.

INTRODUCTION

The ΔV gives evidence of the change of the dipole moment μ , for example in a liquid crystal (LC) layer. In the special case of LC the potential jump, to be registered by the measuring arrangement of the voltaic potential difference $\Delta V_s = 4\pi . n . \mu + \Psi_o$ of the surface[1,2] and the potential drop ΔV_b, changed by reorientation of the LC molecules in the thin layer. In the absence of charge ($\Psi_o=0$) holds:

$$\Delta V = \Delta V_s + \Delta V_b \qquad (1)$$

The voltaic potential difference ΔV was determined using the ionization method with Am^{241} as probe.[3,4] We investigated unoriented as well as planar and perpendicular oriented LC layers on semiconductor surfaces.

EXPERIMENTAL

A GaAs 1,1,0 surface was coated at first with an orientation layer (OL) for a perpendicular ⊥ (polyester) or a planar ∥ (polyamide) arrangement of a nematic liquid crystal.[5,6] This ⊥ or ∥ orientation layer was coated with a thin film (ca. 2 µm) of MBBA. MBBA (I) and EBBA (II) were also spread with a layer thickness of ca. 2 µm on a cleaned GaAs surface[7] without OL.

RESULTS AND DISCUSSION

The results are shown in Table I. When coating the GaAs surface with MBBA we observed a voltaic potential difference ΔV of about 395 mV. In case of an adequate EBBA coating, ΔV was about 290 mV. With a given solid substrate (GaAs) and a relatively constant LC layer we consider these values as specific parameters for MBBA and EBBA.
The determination of the voltaic potential difference is of interest in dependence on the temperature. For the GaAs surface with an MBBA layer the voltaic potential difference changes erratically at 318 K with a ΔV_T of about 115 mV and, for an EBBA layer, at 353 K with a ΔV_T of about 75 mV.

TABLE I Measurement of the voltaic potential difference ΔV between GaAs surfaces and those coated with a thin LC layer*

Substrate	LC	ΔV (mV)	ΔV_T (mV)
GaAs+OL ⊥	MBBA	475	- 85
GaAs+OL //	MBBA	445	100
GaAs	MBBA	395	115
GaAs	EBBA	290	75

OL ⊥ = perpendicular OL
OS // = planar OL
ΔV_T = ΔV in dependence on temperature (ΔT =50 K)
* LC layer thickness of ca. 2 μm

We think the reason for the voltapotential step is the transition from the nematic phase into the isotropic phase in the organic surface layer. This phase transition is connected with a change of the dipole orientation.

The clearing point for MBBA is 320 K and for EBBA 353 K. The voltaic potential difference ΔV between the OL ⊥ and the MBBA coating of the substrate is about 475 mV. Between the GaAs surface with an OS // and those coated with MBBA we observe a difference ΔV of about 445 mV. It means that through a homogeneous arrangement of the dipole in the coated LC layer the ΔV difference is increased. The contrary direction of ΔV_T (-85 mV and + 100 mV) results from the diverse spacious arrangement of the dipole μ of the LC molecules before their transition into the isotropic phase.

REFERENCES

1. K. Möhring, Zeitschrift für Elektrochemie, 59, No. 2, 102 (1955)
2. V. Vogel and D. Möbius, J. Coll. Interf. Sci, 126, No. 2, 408 (1988)
3. G. Kretzschmar and H. Fruhner, Z. phys. Chemie, 256, No. 1, 169 (1975)
4. A. Seeboth and G. Kretzschmar, Z. phys. Chemie, in press
5. A. Seeboth, J. Inf. Rec. Mater, 15, No. 3, 197 (1987)
6. A. Seeboth and L. Petzold, Z. phys. Chemie, 270, No. 4 (1989), in press
7. W. Kern, Semiconductor International, April (1984), p. 94