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ON THE CONTROL OF NEMATIC LIQUID CRYSTAL ALIGNMENT

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ABSTRACT

Liquid crystal displays (LCDs) are incorporated in a great variety of electronic devices such as laptops, mobile phones, TV sets, etc. The performance of LCDs depends strongly on the alignment of liquid crystal and therefore the reliable control of the alignment parameters, such as pretilt and anchoring strength, is of vital importance for the LCD industry. In this thesis are presented the results of the study of two categories of new alignment materials. The first category is composite photopolymerizable materials containing perfluorinated and siloxane units promoting uniform and thermally stable vertical alignment due to segregation and self-assembling of the fluorinated units. The performed study on the quality of the alignment, promoted by these materials at different relative concentrations of the components, and on their electro-optical characteristic and anchoring strength, showed that these materials are promising alignment materials which are good candidates to be employed in LCDs. The second category is two kinds of novel photoalignment materials. The study of these materials revealed the relationship between the molecular structure of the materials and their alignment ability, information which is very important for design of photoalignment materials for LCDs. Another study performed within this thesis revealed that the anchoring is not only a property of the solid surface, which is in contact with the liquid crystal, but also depends on the properties of the liquid crystal bulk such as ionic density, dielectric anisotropy and flexoelectric polarizability. This observation revealed the possibility for control of the anchoring properties and thus of the electro-optic characteristics of LCDs, in general, and of the response time, in particular. Important part of the thesis is devoted to study the necessary conditions for efficient control of the pretilt in LCDs. The results of this study confirmed unambiguously the conclusions derived in the recently suggested theoretical model describing the alignment transition from vertical to planar alignment in the case of presence of two alignment components - vertical and planar.

Keywords: liquid crystal alignment, nematic, photoalignment, anchoring energy, vertical, planar, pretilt, self assembling, azo