

Summary

of the doctoral dissertation MSc. Joanna Jaworska

„Investigations of photoinduced phase transitions and filaments in selected azobenzene derivatives”

This doctoral dissertation was written at the Wrocław University of Technology under the supervision of prof. Stanisław Bartkiewicz. The work consists of eleven chapters. The first chapter is an introduction to the topics presented in the dissertation and explains the motivation for the research. The second chapter briefly characterizes the content of this work by presenting its macroscopic image. Then, in the third chapter, the purpose and scope of the research are described and the thesis of the dissertation is formulated. The next chapter is devoted to the basic concepts related to liquid crystals. A historical outline and a precise definition and division of these materials are presented. Then, this group was narrowed down to azobenzene derivatives and their characteristics were presented. In the following part, the phenomenon of photoisomerization, on which the entire work is based, is characterized. Subsequently, the light influence on the phase transitions in liquid crystals is described and an explanation of this mechanism is provided. Finally, a description of specific structures appearing in liquid crystal systems is presented. These structures are called as filaments and have been previously studied in multi-component systems. At the end of the chapter, the way of describing the phase situation for such systems as well as for one-component systems is also presented. The fifth chapter focuses on characterizing the experimental techniques used in the research. Of the nine experimental techniques cited, seven were fully independently used by the author of this dissertation. These were optical polarization microscopy (POM), confocal microscopy (CM), thermo-optical analysis (TOA), differential scanning calorimetry (DSC), UV-Vis spectroscopy, Sackmann-Demus method (SDM) and holographic techniques (DTWM). In the next, sixth chapter of the doctoral dissertation, the studied materials, their structures and applied symbols are presented. Later in this chapter, these materials are subdivided and further characterized using the experimental techniques mentioned in Chapter Five. This part of the work focuses primarily on basic research through which it was possible to determine the influence of the chemical structure of materials on their liquid crystal properties, the richness of the polymorphism shown, or the temperature of phase transitions. Comparative analysis of the results from the above-mentioned subgroups allow to select materials for further optical research. These studies are the subject of chapter seven, in which, by the use of UV-Vis

spectroscopy, it was possible to characterize the optical sensitivity of selected substances. In addition, the kinetic rate constants of switching between trans-cis-trans isomers was determined in the tested compounds. This parameter is a key element showing whether the tested materials have a chance to be used in optical applications. The next chapter focuses on the influence of light on the polymorphism of the investigated materials. In order to better illustrate this issue, a new method of creating phase diagrams was created and described. In such systems, an attempt to record diffraction gratings was made and this process is described later in this chapter. Finally, new structures were presented, the generation of which in the investigated liquid crystal systems is possible only with the use of light. These structures were characterized, and their controllability was investigated. Chapter 9 summarizes the most important results obtained in this dissertation. On their basis, conclusions were presented and reference was made to the research thesis of the work. The last two chapters (10, 11) collect literature that has been repeatedly referred to in this work and present the author's scientific achievements.

The results of the research carried out as part of this doctoral dissertation have been published in 6 scientific publications and presented at many conference presentations.