STATEMENT

On a dissertation for acquisition of the educational and scientific degree "Doctor" in professional field 4.1 Physical Sciences, scientific specialty "Electrical, magnetic and optical properties of condensed matter", authored by Blaga Hristova Blagoeva, full-time doctoral student at the Institute of Optical Materials and Technologies (IOMT) - Acad. Yordan Malinovski, Bulgarian Academy of Sciences.

Title of the thesis: Photoanisotropic media for optical recording, sensitive in the visible and ultraviolet spectral regions.

Statement prepared by: Stefan Tsvetanov Valkov, Assoc. Prof., PhD, at the Acad. E Djakov Institute of electronics, Bulgarian Academy of Sciences

The PhD thesis, entitled "Photoanisotropic media for optical recording, sensitive in the visible and ultraviolet spectral regions", consists of a list of symbols and abbreviations used, an introduction, three chapters, a conclusion, main contributions, a list of publications, citations of publications, conferences and projects on the basis of which the dissertation is built, as well as a list of references. It is written on 146 pages, contains a total of 66 figures and 12 tables. 223 references are cited.

The dissertation is dedicated to the optimization of parameters for inducing birefringence and polarization holographic recording in photoanisotropic materials. The advancement of optical technologies plays a critical role in modern communication, medical, and industrial applications. Particularly, the enhancement of communication network speeds and the efficient, reliable exchange of information are of paramount importance in today's interconnected world. Additionally, the application of these technologies in medical imaging and diagnostics offers tremendous promise due to their high precision and minimal side effects, paving the way for improved accuracy in diagnosis and treatment. Given the growing demand for innovations in communication and medical fields, the development of optical technologies is poised to significantly improve the quality of human life. The work presented in this dissertation addresses key challenges in the optimization of optical systems, making it highly relevant to both academic research and practical applications in various industries. In my opinion, the relevance of the dissertation, the goals and objectives, as well as the significance of the results obtained are beyond doubt.

Within the literature review, included in Chapter 1, detailed information on photoanisotropic materials is presented. The mechanism of inducing birefringence is described in detail, as well as its influence on the efficiency of supramolecular chiral structures and polarization

holographic gratings recorded in these media. The influence of chiral structures on diffraction efficiency is presented. A literature review of the main studies and results on the topic is made. On this basis, the goals and objectives of the dissertation work are defined. In my opinion, the PhD student is well aware of the state of the problem, as well as the world scientific literature. This is confirmed by the 223 cited references, of which over 180 are included in the literature review. Chapter 2 presents the characterization and preparation of thin layers and films from the materials used for the needs of the dissertation work. The drying processes are observed in detail using the method of dynamic speckle analysis. The photoanisotropic parameters are analyzed. Chapter 3 discusses the recording of polarization-selective optical elements and structures. The formation of supramolecular chiral structures that act as an optical switch in some of the used azo-media is demonstrated. The effect of the film thickness and the type of solvent on the properties of an optical element in the form of a circularly polarized beam splitter is analyzed. An originally new method for improving its polarization properties is also developed. Also, a summary of results for the values of birefringence, dichroism and diffraction efficiency of thin layers of azo dyes in a polymer matrix is made, presented in the form of an appendix to the thesis. On this basis, the selection of the azo dyes used in the dissertation was made.

As a result, original new knowledge has been obtained about the spectral dependence of birefringence induced in the azopolymer PAZO. It has been proven that this azopolymer can be applied for the recording of polarization diffraction elements serving in a wide spectral range. The optimal concentration of the azo dye DR1 relative to the PMMA matrix has been specified, at which the maximum value of birefringence significantly exceeds the results published in the scientific literature. The optimal wavelength for optical recording in the azopolymer used has been established, and birefringence has been successfully induced in various environments with ultraviolet radiation. The possibilities for the materials used to serve as environments for the development of optical elements operating in the entire visible region are presented. A novel method has been developed to enhance the polarization properties of an optical element, specifically a circularly polarized beam splitter, by preventing the formation of surface relief. This is achieved through the deposition of a transparent adhesive and the placement of a microscope glass on the surface of the azopolymer. The effect of the type of azopolymer solvent on the optical quality of the layers obtained from the solutions as well as on the parameters of surface relief lattices has been studied and specified. Supramolecular chiral structures have been developed, serving as an optical switch. In my opinion, the contributions presented in the dissertation are original, well formulated and characterize the PhD student as an established specialist in the field of the thesis topic.

The results obtained have been published in 9 articles, three of which are in journals with an impact factor. One of these publications has been assigned quartile 1 (Q1), and the other two - quartile 2 (Q2). The other articles are reports from international conferences, published in full text. I would like to mention the prestige of the international journals in which the main part of the results of the thesis have been published, such as *Photochemical and Photobiological Sciences*,

Photochemistry & Photobiology A: Chemistry and *Thin Solid Films*, as evidenced by their high impact factor and quartile. This, together with the significant number of citations that these publications have received, significantly highlight the significance of the results obtained and contributions, as well as the relevance of the topic. In most of the publications, the PhD student is the first author, which proofs her personal contribution. This publication activity significantly exceeds any requirements and criteria for obtaining the educational and scientific degree "doctor", both according to the Law of the development of the academic staff of Republic of Bulgaria, and the internal criteria of the Institute of Optical Materials and Technologies-BAS.

The thesis is written in clear and correct language. The aims and objectives, as well as the conclusions and contributions are defined clearly and precisely.

The abstract is written precisely and clearly. It correctly reflects the main results and contributions obtained in the PhD thesis.

I would like to express my impressions about Blaga Blagoeva, whom I know as a competent and dedicated researcher. I have always been impressed by the enthusiasm with which she discusses her scientific and research activities. She has always given competent and reasoned opinions. Obviously, these qualities have been noticed not only by me, which is confirmed by the award of the Bulgarian Academy of Sciences for achievements in the scientific field of "nanosciences, new materials and technologies", for the youngest scientists below 30 years old for 2023, an award for the best poster presentation at the VII National Student Scientific Conference on Physics and Engineering Technologies, and other diplomas and awards.

In conclusion, I would like to confirm that the tasks have been performed at the highest scientific level, and the defined aims have been fulfilled. A significant amount of scientific research work has been carried out, and the results achieved significantly exceed the requirements for acquiring the educational and scientific degree "doctor", both according to the Law of the development of the academic staff of Republic of Bulgaria and according to the regulations of the IOMT-BAS. For this reason, I express my definite opinion that the educational and scientific degree "doctor" should be awarded to Blaga Hristova Blagoeva in the professional field 4.1 Physical Sciences, specialty "Electrical, magnetic and optical properties of condensed matter".

07.01.2025 Author.....

Sofia /Assoc. Prof. Dr. Stefan Valkov/