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Opinion

on a dissertation for the acquisition of the educational and scientific degree "Doctor" in professional field 4.1. Physical Sciences, scientific field "Electrical, magnetic and optical properties of condensed matter" under a defence procedure at the Institute of Optical Materials and Technologies "Academician Yordan Malinovski", Bulgarian Academy of Sciences.

Author of the dissertation: Blaga Hristova Blagoeva.

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

Prepared by: Assoc. Prof. Dr. Lyubomir Ivanov Stoychev, Institute of Solid State Physics "Academician Georgi Nadzhakov", BAS, member of the Scientific Jury according to order No. RD-15790/21.11.2024 of the Director of IOMT-BAS.

The goal of the research presented in the dissertation is clearly formulated at its beginning – establishing the optimal parameters for inducing birefringence and for polarization holographic recording in photoanisotropic materials sensitive in the visible and ultraviolet spectral regions. To achieve it, five tasks have been set. Four of them are experimental: deposition of thin homogeneous layers with good optical quality, determination of their photoanisotropic parameters, tracking the parameters of recording and erasing birefringence, investigation of the spectral dependence of birefringence induced in an azopolymer and subsequent preparation of polarization diffractive optical elements and an optical switch from the obtained samples. The last one is computer modelling of the diffraction efficiency of surface relief gratings in an azopolymer, which allows an optimization of the workflow when planning future research.

The dissertation examines various photoanisotropic media sensitive in the visible and ultraviolet spectral regions. The role of individual factors in inducing birefringence and in polarization holographic recording in these media is determined. The conditions at each stage of the development of optical elements based on these media are optimized - from the processes of layer deposition to the recording of the elements, which is of great importance for their high efficiency and reliability.

The first chapter provides an extensive overview and analysis of the issues of the dissertation, and in particular of the molecular processes inducing linear and circular birefringence in various (commercially available) photoanisotropic organic materials under the influence of polarized light, using 182 references. It is explained why high values of birefringence are of great importance in media intended for optical recording and for the development of optical switches and polarization diffraction elements. The overview was used to formulate the main tasks of the research presented in the dissertation. The second chapter describes the characterization and preparation of thin layers of the photoanisotropic materials considered in the dissertation. The surface topography, microstructure and micromechanical characteristics of some of them were studied and their photoanisotropic parameters were compared when irradiated with linearly polarized laser light from the visible and ultraviolet spectral regions. In the third chapter, the recording of some polarization-selective optical elements and structures is considered. The formation of supramolecular chiral structures acting as an optical switch in some of the studied azo environments is shown, after which the reversibility of the direction of the chiral structures by changing the sign of the ellipticity of the polarization of the input radiation is studied and compared. The recording of polarization holographic gratings in the azopolymer PAZO is described and a method for improving the polarization properties of a circularly polarized beam splitter is proposed.

The research results presented in the dissertation have been published in 9 papers, one of them has a quartile of Q1, two have a quartile of Q2 and three have a SJR impact rank. This number is well above the average number of publications used to obtain the educational and

scientific degree "Doctor", and significantly exceeds the minimum requirements set out in the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria. Very impressive is the fact that Blaga Blagoeva is the first author of five of the publications, and it should also be emphasized that 14 citations of these publications have been noted.

I believe that an extremely valuable contribution of the dissertation is the Appendix to the dissertation, where the values of birefringence, dichroism and diffraction efficiency of thin layers of azo dyes in a polymer matrix (guest-host systems) are compared for 52 systems of this type.

I have no critical remarks about the presented materials. There are a few terminological and grammatical inaccuracies that do not in any way hinder the understanding of the presentation.

Particularly impressive is the enormous experience that Blaga Blagoeva has gained while working on her dissertation: participation in a total of 15 projects, co-authorship in 40 publications, of which 33 with impact factor or impact rank, participation in 40 scientific forums with a total of 69 reports, of which personal participation in 16 with 18 reports delivered and two first prizes won, member of an expert group at the National Agency for Assessment and Accreditation (NAAA). It is also worth highlighting the awards won in 2023: Award "Outstanding Young Scientist in the Field of Optical Materials and Technologies" - IOMT-BAS and, above all, the prestigious "Ivan Evstratiev Geshov" Award for young scientists under 30 years of age for achievements in the scientific field "Nanosciences, New Materials and Technologies" - Bulgarian Academy of Sciences.

Conclusion. I do not know Blaga Blagoeva personally, but the scientific results presented in the dissertation show that an extremely large volume of experimental research work has been carried out using modern methods and techniques of work, as well as that the tasks set in the dissertation have been fulfilled at the highest professional level and the formulated goal has been achieved. From this it can be concluded that the candidate possesses in-depth theoretical and experimental knowledge in her prefessional field and the ability to conduct independent scientific research. I have no doubt in the originality of the presented results, and the topic is undoubtedly topical, as evidenced by the large number of participations in scientific forums, the significant number of publications and noted citations, as well as the six projects that partially financed the activities on the work on the dissertation. The results in it significantly exceed the requirements set out in the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulation for its implementation, as well as the requirements of the educational institution - IOMT-BAS, for awarding the educational and scientific degree "Doctor". Based on the above, I strongly recommend and support the awarding of the educational and scientific degree "Doctor" in professional field 4.1. Physical Sciences, scientific specialty "Electrical, Magnetic and Optical Properties of Condensed Matter" to Blaga Hristova Blagoeva.

07.01.2025
Sofia

Prepared the opinion:
/Assoc. Prof. Dr. Lyubomir Stoychev/