

# Opinion

on the thesis (dissertation paper) entitled  
„Spontaneous deformations of emulsion drops undergoing phase transitions“  
presented by the regular PhD student Diana Peychova Cholakova  
for the educational and scientific degree “Doctor of Philosophy” („Doctor“)  
in Specialty 4.2 Chemical sciences (Physical chemistry – Macrokinetics)  
by Assoc. Prof. Dr. Krastanka Georgieva Marinova, Faculty of Chemistry and Pharmacy, Sofia  
University, Member of the Scientific Jury (panel) appointed with Order № 38-144/20.03.2020 of  
the Rector of Sofia University

The presented thesis is devoted to the study of non-trivial deformations of emulsion drops, which have been the subject of intensive research in the last 5 years. The PhD student Diana Cholakova has started working on the topic as a student, and as a result she is a co-author of 13 scientific publications so far, 12 of which devoted to the topic (11 co-authored with the supervisor and colleagues, and one independent in the popular scientific magazine *BBC Knowledge* (Bulgaria)), and her supervisor Prof. Denkov is a co-author of 2 more works on this topic without her participation.

Since the first publication in *Nature* in 2015 these publications have more than 75 citations in the scientific literature so far, which demonstrates a wide scientific interest and the high relevance of the topic.

The thesis of Diana Cholakova includes materials from 3 scientific publications, which are published in journals with high Impact Factor (*Advances in Colloid and Interface Science* and *Langmuir*). These three papers have already 17 citations according to the information provided. Diana Cholakova presented the results at 8 international and national conferences with 2 posters and 6 oral presentations, and her supervisor and her co-authors presented reports at 6 more national and international forums.

The reported results were well accepted at international conferences, as witnessed by the awards received for the best poster in 2016, and for the best oral presentation (Enzo Ferroni award at ECIS-2019), I have attended some of these presentation in personal, which confirms the importance and the relevance of the topic of the dissertation, and demonstrates the excellent presentation skills of the doctoral student.

The minimum national requirements for a doctoral degree are also formally met:

- indicator group A - dissertation work for obtaining the educational and scientific degree "doctor" - 50 points out of minimum required 50 points;
- indicators group D - 3 scientific publications in Q1 - 75 points out of minimum required 30 points.

The thesis consists of five chapters. Chapter I “Introduction. Aims of the study and structure of the Thesis” and chapter 2 “Materials and experimental methods” introduce the topic and problem, the studied systems and the applied experimental approaches and instrumentation. The obtained results are presented in the next three chapters, in which various model are analyzed in detail and sound conclusions are drawn about the controlling factors (Chapter 3), the deformation mechanism (Chapter 4), and a theoretical interpretation of the results for determining the thickness and the mechanical strength of the layers in the different systems (Chapter 5). This presentation of results does not follow exactly to the content of the three articles on which the thesis is based. The arrangement of the results in the thesis presents in a more structured and consistent way the observed phenomena in the different systems, including the surfactants

classification into Groups A, B, C and D (published in the article in *Advances in Colloid and Interface Science*, 2016), the mechanisms of deformation for the different groups (according to data from the articles in *Langmuir*, 2016 and 2019), and the theoretical analyzes (summarized from the two articles in *Langmuir*, 2016 and 2019). The circumspect analysis of at least two different scenarios to explain the mechanisms is highly impressive. I find the conclusions to be substantiated, supported by verified experimental facts and self-consistent theoretical models.

It is evident from the thesis paper that numerous experiments with different oils (alkanes, alkenes, alcohols, etc.) and surfactants (various nonionic, anionic, cationic) have been conducted and analyzed in detail. In addition to the microscopic observations upon variations of the cooling and heating rates, and the initial droplet size, interfacial tension measurements, differential scanning calorimetry (DSC) measurements, and small angle X-ray scattering (SAXS) analyzes were also performed. Diana Cholakova has conducted herself most of these measurements, and she has had a leading role in the development of some of the applied procedures. The obtained results prove well her high skills and abilities, diligence and attention to every detail. I am well convinced that Diana Cholakova has made a substantial contribution to the precise geometrical models for determining the thickness of rotary phases, as presented in Chapter 5, and in the Supplementary information of the 2019 *Langmuir* article. Undoubtedly, the presented work is original and authentic, and the doctoral student has a major contribution to obtaining these new and important scientific results.

The presented thesis paper and the Summary are written very concisely, clearly, using precise and accurate statements. All figures and photos are properly selected, informative and of high quality. Undoubtedly, Diana Cholakova is well acquainted with the current state of the problem, as evidenced by the exhaustive reference list with 142 cited sources, as well as by the review she is a co-author of "Rotator phases in alkane systems: In bulk, surface layers and micro/nano-confinements" in *Advances in Colloid and Interface Science* 2019, which is not included in the thesis paper.

I am highly convinced that Diana Cholakova is a young researcher with a high capacity, solid knowledge, commendable scientific curiosity, and a good experience already, for high excellence in her future research.

### **Conclusion**

The presented excellent results, and my personal impressions of the doctoral student and her work, together with the fulfilled formal indicators that fully comply and even exceeds the requirements of the Act of Development of Academic Staff of the Republic of Bulgaria, make me confidently give a POSITIVE assessment of the work, so I recommend to the Scientific Jury to award Diana Peychova Cholakova the educational and scientific degree "Doctor".

8.05.2020

Sofia

/ Assoc. Prof. Dr. Krastanka G. Marinova /