

Foreword to the 2nd edition

The original foreword to this book's first edition said that its intention is to converge polymer chemistry and physics, such to also converge the striking specificity and ubiquitous universality of polymers. Based on that intent, the aim of this book was sketched to be a bridge between polymeric structures & dynamics and their resulting properties, thereby arcing between macromolecular science and engineering. This bridge has been identified to be the field of physical chemistry of polymers. It was also said that a major challenge in that context is that the concepts in physical chemistry of polymers commonly appear to be rather new and unknown to students, and that it is therefore a mission of this book to converge deep conceptual understanding (with many excursions into the underlying basic physical chemical concepts) with solid mathematical formalisms.

All the foresaid still holds true just as well for this present second edition. Yet, there is a further aspect to be added: Just when the first edition appeared, the world fell into a pandemic era, which shifted minds, societies, and universities. It also shifted teaching formats, catapulting us into the digital age. Well, actually we should have been in that era way before: In the 15th century, the invention of movable-type printing by Gutenberg in Mainz ushered in the second media revolution in human history. (The first before that was the transition from spoken to written language, and the third after that was the advent of electronic mass media.) Today, the world is in the fourth media revolution: digitization and networking. However, until recently, universities (almost) exclusively taught in a way that dates back to pre-Gutenberg times: frontal lecturing. The pandemic of the SARS-CoV2 pathogen in 2020, just when the first edition of this book appeared, eventually propelled the academic world into the 21st century and established digital teaching formats. This textbook provides a basis for such a format in the subject of physical chemistry of polymers. It is a basis for a blended learning course, i.e., a teaching format that consists of a self-study phase (knowledge acquisition), a digital feedback unit (knowledge anchoring), and an interactive classroom unit (knowledge application).

For this purpose, the book is divided into 23 thematically focused and modularly applicable lesson units, which can be conceived as 90-min lectures each. This number marks a plus of five new lesson units to the former eighteen ones of the book's first edition, adding to its general polymer-physical concepts some specific material-centered contents. With that, the second book edition can be used in its entirety for a 12-week course of 2×90 minutes per week (this corresponds to 4 SWS in the German system). Alternatively, it can also be used for two separate, sequential courses of only 1×90 minutes per week each (corresponding to 2 SWS in the German system), one covering lesson units 1–9 and one adding lesson units 10–23 (perhaps cutting unit 19 if time is too tight).

The lesson-unit blocks each comprise about 10–20 pages, each to be worked through in about 90 minutes of self-study. Each unit concludes with a set of conceptual questions in a multiple-choice format. Lecturers can incorporate some of those into an e-learning platform so that students can solve them there right after reading the teaching unit. Many e-learning platforms even allow in-situ feedback texts to be added to the respective answer options, which then immediately indicate to the students whether and why their selected answer option is incorrect or correct. The author of this book is happy to provide lecturers such answer texts for the questions included here upon request. From the answer statistics, which can also be easily generated in many e-learning platforms, lecturers can then see which aspects of the topic are already well understood in the student group and which are not, such to then tailor the subsequent classroom session accordingly. In addition, further of these multiple-choice questions can be used in this attendance unit to further deepen the material. This may best be realized with the peer instruction method: In this approach, a conceptual multiple-choice question is projected in the classroom, and the students first answer individually with the aid of an audience response system (“clicker system”, e.g., smartphone-based). The response statistics, which are then also projected by the teacher, give the students direct and anonymous feedback on how their own selected response fits into the overall cohort. Afterwards, the students are asked to exchange themselves with their peers around them in groups of two or three, with the task to convince them of the correctness of their first chosen answer.

A second round of voting after a few minutes will then almost always produce the correct result with a clear majority, simply because those who have had the correct answer in the first place also have better arguments and can understand and eliminate any gaps in their peers’ understanding — much better than any lecturer ever could. That way, the students take an active role in deepening their knowledge, are stimulated and motivated, and are interactively involved in the learning process on several levels . . . whereas the lecturer merely takes the role of a moderator. With that, the method fulfills one of the core claims of its inventor, Prof. Eric Mazur (Harvard): “*good teaching is to help students learn.*”

As attractive as this teaching method may seem at first — it stands and falls with the quality of the questions asked; and even more with the quality of the given answer options. If it is immediately obvious which answer is the correct one, the method is at best entertaining, but not particularly instructive. If, by contrast, one of the answer options represents the “most common misconception”, i.e., the most common and typical initial misunderstanding that students often have, then this can be specifically addressed and eliminated. This is exactly where this book comes in. It aims to provide well thought-out and prepared material for all three of the above-mentioned teaching phases (self-study, e-learning feedback, and in-person consolidation unit).

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