

Preface

Why for heaven's sake a book on nanotubes or nanopore? Just another summary of nanoscale gimmicks without any hope for future engineering? The answer is in fact yes and no. Nanotubes and nanopores are probably the most fascinating materials on the nanoscale due to one simple reason: We can barely fabricate tubes and pores on the nanoscale top-down with a perfection such as carbon nanotubes and we are still puzzled by the elegant functionality of biological ion channels. At the same time we have clever bottom-up synthesized materials though it is not clear how we can solve the tremendous engineering problems associated for rational device architectures. When it comes to real-world applications the tubes and pores have obviously tremendous potential though only a few start-ups have currently products on the market. Limitations for new tube products are often related to the lack of sufficient bulk quantities and purity of the materials. For example in the case of carbon nanotubes the scattered intellectual property on material synthesis is one of the reasons why nanotube products are still in their infancy.

The idea to a book on nanotubes and nanopores was the result of two symposia at the Material Research Society (MRS) conference held at Boston and San Francisco which the editors organized and where we realized that working interdisciplinary is still more of a buzzword in the community. Furthermore, we have been able to organise an exploratory workshop funded by the European Science Foundation (ESF) on nanowires and again experienced that the highly heterogeneous mix of scientists was one of the most fruitful experiences to exchange ideas across scientific borders though it is difficult to keep track on the exponential increase of applications. Thus, it was time to write something down not for all low-dimensional materials but for the least accessible materials from an engineering point-of-view: nanotubes and nanopores.

Within this book we tried not to cover all aspects of tubes, which would go beyond the scope of the editors, but rather introduce the readers to tubular structures from biological, organic and inorganic materials as well as their functionality. Some nanotubes are synthesized by ingenious chemistry and others are spontaneously formed by physical processes which we often do not understand in detail. With respect to functionality we tried to cover the most interesting aspects of tubular materials, which should allow the readers to evaluate the potentials for these new

materials and derive some rule of thumb for their own research or interest. Last, we have been adding chapters on top-down technologies which can be used to fabricate rational tubular structures on the nanoscale to give the reader an impression how creative scientists and engineers start to be when it comes to small holes. In most chapters the readers will find some critical theory to understand the physics as well as detailed descriptions of the chemistry applied. Furthermore, the authors of the chapters were asked to be critical about their own work and to explain critical experiments thoroughly.

However, one should not expect to have a student textbook in his hand but a highly interdisciplinary book covering material synthesis, electronics, optics, and membrane science where basic understanding of the physics and chemistry is required to understand the content. This might also be the hint for the decision making process why to purchase our book on tubes and pores. Anyone who is interested in both applied science and engineering will probably benefit most.

Last, we would like to thank all authors who have put much effort in their chapters. It was quite difficult to convince the principal investigators in academia and industry to participate. Some of the new exciting topics could not be covered such as sequencing with nanopores. Nevertheless, we believe that the selected topics are a good starting point for readers to think about material and engineering issues with nanotubes and nanopores.

Only recently one of the PI's, Prof. Dr. Ulrich Goesele, director of the MPI for Microstructure Physics at Halle, Germany, passed away. His outstanding contributions to materials physics and chemistry which regularly led to key innovation for industrial applications will be remembered. Our book is a tribute to him.

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