



Handbook of Nanoindentation: With Biological Applications

By Michelle L. Oyen

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Nanoindentation is ideal for the characterization of inhomogeneous biological materials. However, the use of nanoindentation techniques in biological systems is associated with some distinctively different techniques and challenges. The book presents the basic science of nanoindentation, including the background of contact mechanics underlying indentation technique and the instrumentation used to gather mechanical data. It provides perspectives that are optimized for biological applications, including discussions on hydrated materials and adaptations for low-stiffness materials. The book also covers the applications of nanoindentation technique in biological materials. Highlighting current challenges, it concludes with an insightful forecast of the future.

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Editorial Review

Review

"Michelle Oyen has done a superb job compiling experts in the field of nanoindentation. This book spans a wide variety of topics ranging from the fundamental theory and instrumentation of nanoindentation to its application in biological materials including soft tissues, mineralized tissues, and cell structures. This book is an excellent resource for students and researchers alike."

?Professor Lisa Pruitt, University of California, Berkeley, USA

From the Inside Flap

Nanoindentation is ideal for the characterization of inhomogeneous biological materials. However, the use of nanoindentation techniques in biological systems is associated with some distinctively different techniques and challenges. For example, engineering materials used in the microelectronics industry (e.g. ceramics and metals) for which the technique was developed, are relatively stiff and exhibit time-independent mechanical responses. Biological materials, on the other hand, exhibit time-dependent behavior, and can span a range of stiffness regimes from moduli of Pa to GPa eight to nine orders of magnitude. As such, there are differences in the selection of instrumentation, tip geometry, and data analysis in comparison with the "black box" nanoindentation techniques as sold by commercial manufacturers. The use of scanning probe equipment (atomic force microscopy) is also common for small-scale indentation of soft materials in biology.

The book is broadly divided into two parts. The first part presents the "basic science" of nanoindentation including the background of contact mechanics underlying indentation technique, and the instrumentation used to gather mechanical data. Both the mechanics background and the instrumentation overview provide perspectives that are optimized for biological applications, including discussions on hydrated materials and adaptations for low-stiffness materials. The second part of the book covers the applications of nanoindentation technique in biological materials. Included in the coverage are mineralized and nonmineralized tissues, wood and plant tissues, tissue-engineering substitute materials, cells and membranes, and cutting-edge applications at molecular level including the use of functionalized tips to probe specific molecular interactions (e.g. the ligand-receptor binding). The book concludes with a concise summary and an insightful forecast of the future highlighting the current challenges.

About the Author

Michelle L. Oyen is a Lecturer in Mechanics of Biological Materials in the Mechanics and Materials Division and the Engineering for the Life Sciences group in the Cambridge University Engineering Department. She holds a BS degree in Materials Science and Engineering and an MS Degree in Engineering Mechanics, both from Michigan State University, and a PhD degree in Biophysical Sciences and Medical Physics from the University of Minnesota. She joined Cambridge Engineering in 2006 following an appointment as Research Scientist at the University of Virginia Center for Applied Biomechanics. She is a member of the Materials Research Society and the ASME Bioengineering Division, a principal editor for the *Journal of Materials Research*, a moderator of *iMechanica* and a founding committee member for the new UK-based bioengineering society.

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