

BOOK REVIEW

***Periodic Materials and Interference Lithography
for Photonics, Phononics and Mechanics***

M. Maldovan and E. L. Thomas, 313 pages, ISBN 978-3-527-31999-2, Wiley-VCH Verlag, Weinheim, Germany (2009), \$175.00, hardcover.

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Current technology offers a multitude of ways to create nanoscale structure. Maldovan and Thomas give an overview of one particular method for creating periodic structure, interference lithography, and then discuss the properties and possible applications of the structures created by this method. In this method, plane waves of light are brought together to form a three-dimensional interference pattern. Exposure of a photoresist material to this interference pattern then results in a three-dimensional periodic structure. The book takes the reader from the ground up and could easily be read by an undergraduate student in physics or engineering at the junior/senior level. In developing the background, the authors cover a wide array of topics including: 3-D Fourier series, point lattices, rudimentary electromagnetics, acoustic waves, photonic and phononic band structures, effects of symmetry on band structure, the photoresist process, and mechanics of elastic materials.

The book is divided into three sections: Theory, Experimental, and Applications. These section titles, however, may be somewhat misleading. The Theory section covers theory only as it applies to the description of periodic structures and their production through interference lithography. Much of the Applications section would be considered theoretical by many researchers, as it is concerned mainly with developing the descriptions of photonic and phononic band structures, and elastic deformation of solids from rudimentary concepts. This section might be described more aptly as: optical and mechanical properties of periodic structures. An exception is the very brief last chapter, which contains possible practical applications of periodic structures. The Experimental section, consisting of a single chapter 20 pages long, provides information on: the production of the interfering beams, various types of photoresist materials, and other practical considerations.

The book offers problems for six out of the nine chapters, and three appendixes with MATLAB programs to perform some of the simpler calculations described in the text. The problems range from qualitative questions checking conceptual understanding to more challenging computational problems. A few problems require the use of the computer programs provided in the appendixes to either reproduce a result shown in the text or investigate a new situation. The three programs provided are useful for calculating: interfering beam amplitudes for maximum contrast in two-dimensional interference patterns, reflectance as a function of frequency for a one-dimensional photonic crystal, and reflectance as a function of frequency for a one-dimensional phononic crystal.

The writing is generally clear. However, a few changes would make a much improved work. Occasionally, the authors use undefined terms. In some instances the definition pops up a paragraph or two later; in other instances the term is left undefined or unexplained. For example, roughly half way through the text, the term "holographic interference lithography" is used without definition; the only other appearance in the book occurs in the index. The

book suffers from a great deal of repetition with a style reminiscent of a college lecture. It is unfortunate that neither the pre-publication reviewers (if any) nor the editors took care to correct some of the English, especially since this is a specialty book unlikely to see another edition. In most cases, the language is merely awkward. However, in a few instances the misuse of language may actually result in misinterpretation by those not familiar with the topic. Use of the two reflectance programs seems well documented with input parameters clearly defined. They are, however, black boxes. A brief explanation of the method of calculation or even a reference would have been much more instructive.

Although unstated, it seems that the book is likely targeted for use as a textbook in a special-topics course at the upper-undergraduate or beginning-graduate level. Because the authors make nearly no assumptions about the background of the reader and develop basic concepts accordingly, students in such a course would be exposed to fundamentals in many areas. The problems at the end of some chapters appeared to be targeted toward this end. They are few in number, however, averaging eight per chapter in the six chapters with problems. Work with the MATLAB programs could provide additional course activities. With supplementary materials the text could serve as a foundation for a stimulating course. It could also serve as an introduction to periodic structures and interference lithography for the curious or those interested in entering the field.