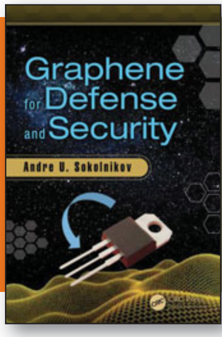


Graphene for Defense and Security

Andre U. Sokolnikov

CRC Press, 2017
282 pages, $175.96 (e-book $197.96)
ISBN 978-1-4987-2762-4

This book is focused on the physics of an interesting material, graphene, with its unique two-dimensional crystal structure that confers special electrical, thermal, optical, and mechanical properties with a wide pallete of possible applications. It contains nine chapters, out of which the first two familiarize the reader with some specific phenomena, such as the Landau level effect and the quantum Hall effect, particularly interesting for graphene developments. The next three chapters deal with the physical properties and quantum mechanics of graphene, while chapters 6–8 report on sources and methods for producing graphene and characterization techniques for graphene-based materials. The last 50 pages of the final chapter are devoted to applications.

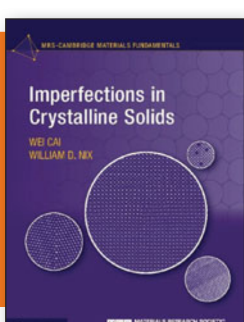
The book develops the basic concepts for understanding the versatility of graphene related to its electronic band structure, which may be engineered by various methods able to break graphene's lattice symmetry, such as defect generation, water adsorption, and interaction with gases. In this context, some of graphene's special properties are explained in detail. Micrometer-sized samples of graphene show some of the best electron mobility values ever measured. As the optical response of graphene nanoribbons may extend into the THz range by using an applied magnetic field, a practical application may be a graphene-based Bragg grating, which is a one-dimensional photonic crystal that is capable of excitation of surface electromagnetic waves in a periodic structure. Such phenomena may contribute to different devices and their improvements: fiber lasers, mode-locking, microwave saturable absorbers, polarizers, modulators in the microwave range, and broadband wireless access networks.

The plasmonic dynamics may exploit optical properties of graphene to design a solid-state laser in the THz range with high efficiency at room temperature. Thermal properties of graphene are also different from those of other carbon materials, such as graphite, nanotubes, or diamond, and the nature of conductivity at the charge-neutrality point has been discussed in connection with graphene-based device fabrication. Moreover, graphene is one of the strongest materials from a mechanical point of view. For instance, graphene exhibits more than 100 times greater breaking strength than steel. The ease of shaping and the firmness of thin graphene layers may facilitate making lighter vehicles and airplanes that use less fuel and generate less pollution. It is expected that graphene could replace silicon technology in many applications by 2020.

The title is a little misleading, as the book is not specific to graphene's applications in defense and security, but it covers applications tangential to these areas, such as those mainly used in electronic devices: a new generation of high-frequency transistors, ultrafast photodetectors, optical modulators, memory devices, energy generation, and energy storage.

In order to take advantage of the information provided in this book, one needs a deep knowledge of quantum physics in solid materials and related phenomena. This monograph based on up-to-date references may be useful for PhD students and specialists in physical engineering and applied electronics.

***Reviewer: Aurelia Meghea** is an Emeritus Professor at the University Politehnica of Bucharest, Romania.*



Imperfections in Crystalline Solids

Wei Cai and William D. Nix

Materials Research Society
and Cambridge University Press, 2016
532 pages, $64.99 (e-book $52.00)
ISBN 9781107123137

In the interest of transparency, MRS is a co-publisher of this title. However, this review was requested and reviewed by an independent Book Review Board.

This book by two acclaimed experts contains an excellent account of the origins and implications of imperfections in crystalline materials, and offers a vivid introduction to the behavior of defects in crystalline materials. The presentation of concepts is superb and is guided by a thorough description of the fundamentals of the chemistry, mechanics, and thermodynamics of defects in solids. The book is distinguished from other solid-state physics and chemistry approaches by illustrating the influence of atomic and microstructural irregularities on macroscopic properties. The contextual elaborations are refreshing and easy to grasp due to descriptive illustrations and an intuitive style reinforced by mathematical derivations. The authors emphasize the importance of the book in preparing materials science and engineering students to understand the behavior of defects in crystalline compounds, but the book is equally suited as a well-configured introduction to specialists and researchers working in the field of materials science and related disciplines.

https://doi.org/10.1557/mrs.2018.171 Published online by Cambridge University Press