Contemporary Physics
Vol. 00, No. 00, , 1–1

Published in *Contemp. Phys.* **53**, 503-504 (2012).

BOOK REVIEW

Graphene: Carbon in Two Dimensions

(*v1.0 released 7 August 2012*)

Graphene: Carbon in Two Dimensions by Mikhail I. Katsnelson, Cambridge University Press, Cambridge, 2012, pp. xiv + 351. Scope: monograph. ISBN 978 0 521 19540 9 (Hardcover). Level: postgraduate students, researchers.

Graphene is a material that invites superlatives. It has been much in the news recently, especially following the 2010 Nobel Prizes to Andre Geim and Konstantin Novaselov for for their "groundbreaking experiments" on graphene. A two-dimensional sheet of carbon atoms linked in a hexagonal lattice, just one atom thick, it is the thinnest known material, is harder than diamond and stronger than steel, while still very stretchable (by up to 20%), has an electrical conductivity higher than copper, and has an exceptionally high thermal conductivity. Despite its thinness, it absorbs 2% of the light passing through it so that, although transparent, it can nonetheless be seen by the naked eye. With such an unusual array of properties, it appears to have huge potential for practical applications. Terahertz electronics, flexible touchscreen displays, single-molecule sensors, solar cells, and composite materials are just a tiny sample of what have already been suggested. Daunting fabrication problems will need to be overcome if these applications are to be realised but, given the level of scientific endeavour and the scale of current investment, the prospects of success appear promising. However, none of these possibilities or problems is discussed in *Graphene.*

Mikhail Katsnelson's book is about the theory of graphene. He says in the Preface that "I have sacrificed all practical aspects of graphene science and technology, and you will not find a single word here about the ways about the ways in which graphene is produced, and there is hardly anything about its potential applications." This is indeed true. Rather, he has written about how the theory of graphene bears on fundamental aspects of physics – the Berry phase and topologically protected zero modes, strongly interacting fluctuations, and relativistic quantum phenomena like Klein tunnelling or vacuum reconstruction. He says that he has written the book in the way he would like to teach a course to introduce the theory of graphene.

He starts at the beginning, with carbon atoms and the electronic structure of graphene, massless Dirac fermions, and what happens to the electronic structure in bilayers and trilayers of graphene. There follow chapters that cover just about everything that one would normally expect to find in a textbook on solid state theory, and more. Just to take a few examples, there is a detailed chapter on the effect of a magnetic field, Landau levels, Berry phase and the anomalous quantum Hall effect. There follow chapters covering e.g. the Klein paradox and chiral tunnelling, edges, point defects, phonons, gauge fields, transport properties, and magnetism. The discussion throughout is erudite and very well-informed. There is hardly any comparison with experiment.

This is very much a theorist's book, about the beauty of idealised graphene, unsullied by the untidiness that one suspects will be introduced by reality in many cases. It is extremely well written and nicely produced, and it can warmly be recommended to all scientists working on graphene or coming to it from other fields. Regardless of whether they are theorists or experimentalists, however, they should bear in mind the possibility that the real material may sometimes behave differently from the idealisation.

Peter V. E. McClintock
Lancaster University
p.v.e.mcclintock@lancaster.ac.uk

ISSN: 0010-7514 print/ISSN 1366-5812 online

DOI: 10.1080/0010751YYxxxxxxxx
http://www.informaworld.com