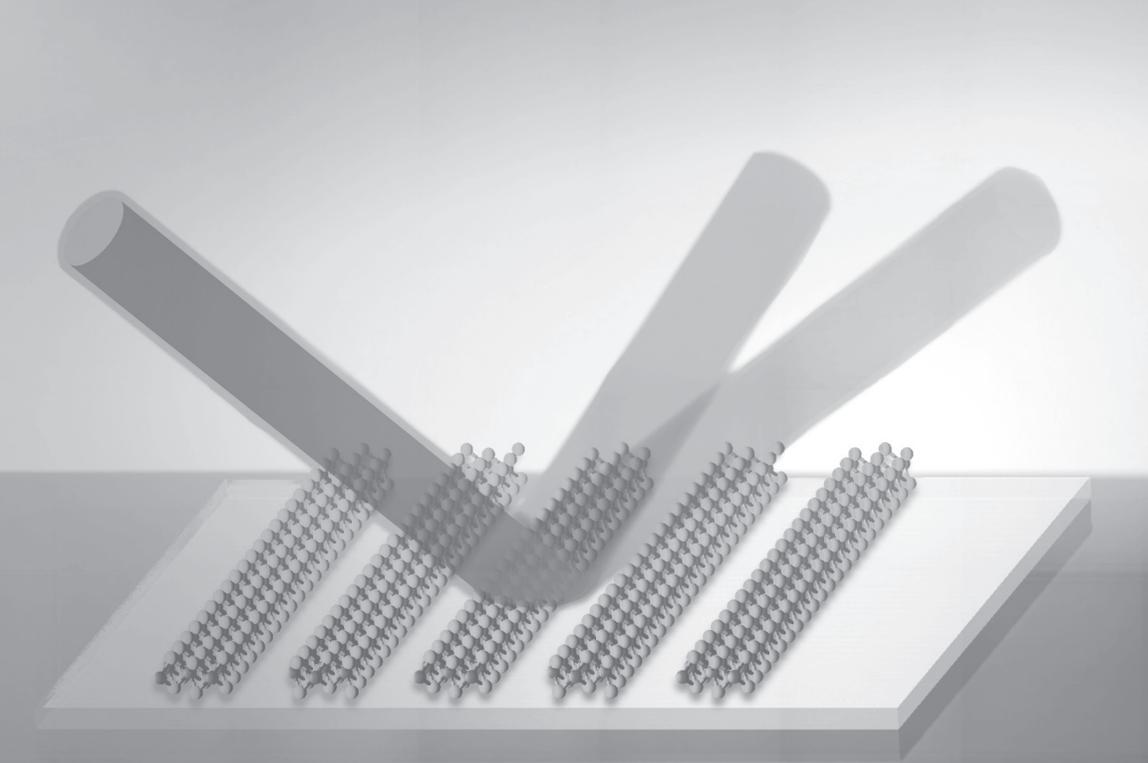
A 3D visualization showing a purple rectangular slab representing a 2D material. On top of the slab, several parallel rows of spheres represent the atomic lattice. A green cylindrical beam of light is incident on the left side of the lattice. Two yellow cylindrical beams of light are shown emerging from the lattice, representing light propagation or scattering. The background is a gradient from purple to yellow.

Two-Dimensional Materials in Nanophotonics

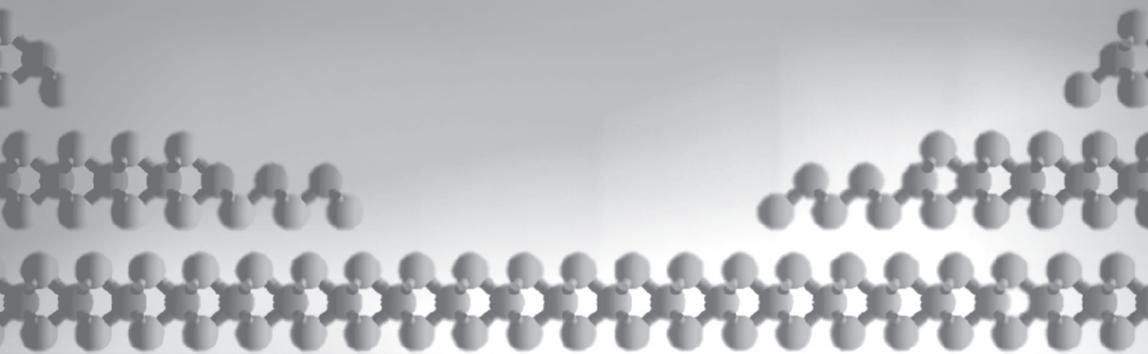
Developments, Devices, and Applications

edited by **Yuerui Lu**





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Preface

Approaching the nano domain and searching for quantum phenomena has always been an emerging topic in science since the discovery of the atom, the fabrication of graphene, the synthesis of further 2D materials and the possibility of nanofabrication techniques. As materials and devices are scaled down into the atomic region, a plethora of scientific discoveries have been discovered with more discoveries emerging all the time; such examples include, strong many body interactions, enhanced light-matter coupling, direct band-gap semiconductors, superior mechanical properties and many more. I edited this book intended for a variety of readers from scientists and engineers working in this field to the undergraduate student who is starting their endeavour towards nano devices, 2D materials, strong light matter coupling and nanophotonics. I was always interested in applied physics and the potential for manipulating new materials for new scientific applications as this has always been the way technology increases, from the transistor in the late 1940's until today where concepts of quantum computing are now a real possibility. My inspiration in science has always led me towards this path of research and working in the fields of 2D materials, optics and nano devices, and this book should serve readers with useful information and insight into the underlying physics as well as the applications of these materials and devices in the future. It is my sincere hope that the work in this book can help scientists in their research endeavours in addition to inspiring young students and researchers in always pursuing high quality impact research for practical applications. I have always known that inspiration and motivation are key for driving new science and the persistence to continue even after many experimental failures. I will always encourage young scientists to pursue what they are passionate about and to never give up on their dreams.

This book starts with the background physics needed to understand 2D nanophotonic devices before it digs deeper into the realm of lenses and gratings, optical pulses and the integration of

these systems into more complex devices. This book came about from my own thoughts and passions towards 2D nanophotonic research and my aim is that this book will direct and inspire future work in this field and attract many new researchers towards aiming for 2D nanophotonic devices. I believe this book will serve as an exemplary reference for the potential of 2D nanophotonic devices for future devices and applications ranging from biomedical measurements, optoelectronic devices and many more. While this book starts with fundamental physics pertaining to nanophotonics, it ends with the ability of nano plasmonic structures and their manipulation and on chip devices which will be essential for future devices involving nanophotonic applications. I particularly wanted to arrange this book in a simple but effective manner to guide individuals into the realm of 2D materials and 2D nanophotonic devices. In preparing this manuscript, I thought about the structure for a long time to give it the most effective way to communicate the technical work, relate theory and experiments, inspire and motivate individuals. I believe the structure and the chapters written in this book are detailed for explaining each topic and highly commend the authors of all sections in this book for their detailed expertise, time and commitment.

I have been doing research in these fields since my undergraduate degree, doctorate and have steadily pursued in this field since that time. My passion for nanotechnology has grown over the years as technology has consistently upgraded and more avenues and possibilities emerge daily. Nanophotonic device and applications will play a significant part in the future of technology and will enable improved solar cell efficiency and nanotechnology applications for space. This growing field makes always pursue new avenues of research, fabricating devices and finding new applications as well as improving efficiency in other technologies. I really had strong motivation towards nanophotonic devices due to their high applicability in solar cells which is something the world is looking for steadily. I hope this book will also inspire many students and other scientists in exploring new devices and applications to allow the field to grow and bring about many new applications. It is also my hope that this book may be used a classroom reference in addition in the future as nanotechnology, 2D materials and photonics is rapidly increasing around the world. Moreover, it is my intention that this book can be available in labs around the world so that all may benefit

from it as I believe science is a strong motivator for the individual and for society.

During preparation of this book, I would like to thank my family, friends and students for their support and welcomed feedback. I would particularly like to thank the author of the chapters for the high quality research and technical expertise in addition to their outstanding professionalism. Moreover, I highly thank the publishing group for their tireless efforts in helping to arrange the book, copyediting and their feedback and advice. Without the help of all these possible the quality and presentation in this book isn't possible, so you have my sincerest thanks. Whilst many hours went into conceiving this book, writing it and preparing it, there were many difficulties to overcome, however, thanks to my family for their outstanding support in being patient with me and always giving me welcomed support. I am also grateful to all of my own supervisors throughout university for developing me into the scientist I am today, without their teaching this work would also not be possible. I am also highly grateful to my colleagues at the Australian National University for their feedback and always having me as a great friend. To my collaborators around the world, your commitment to science and high quality work has always been outstanding and it has been my greatest pleasure to be working with so many distinguished researchers. Everyone will always be my friend and I am sure we will continue to work for many years to come. Without the help of all these people, this book is not possible and they always have my sincerest gratitude. To the readers of this book, I will always say that science is about exploring the unknown and generating ideas is key so never give up and always pursue your goals and dreams.

