

Preface

For many hundreds of years, photonic materials have captured the attention of researchers, philosophers, and the general public alike. Initially, this was due to the bright and vivid colors that the materials exhibit. For example, the beautiful colors of butterfly wings, many beetles, and the opal gemstone are a result of the way light interacts with the material's structure—all of these examples can be considered photonic materials. Furthermore, many nanoparticles (such as Au and Ag) can absorb specific wavelengths of light as a result of surface plasmon resonance—this phenomenon is responsible for the color of many old pieces of stained glass and many other works of art. Nowadays, the focus of photonic materials has shifted from their beauty to their application.

Important applications of photonic materials include sensing, biosensing, and display devices—these topics are all detailed in this volume. There are a number of examples that clearly illustrate how the structure of a material can interact with light to yield color (and other unique optical properties). One very well-known class of such materials are called colloidal crystalline arrays made by packing colloidal particles in an ordered fashion (typically hexagonal close packed) into a volume. The ordered arrangement of the colloidal particles interacts with light to reflect specific light wavelengths, oftentimes yielding color. Many have embedded these ordered particle arrays into responsive polymer matrices, which can change the lattice spacing of the colloidal crystalline array, to yield a change in the material color (and optical properties). These materials have been exploited to sense species of interest in their environment and for display devices. Layered and other structured materials have also been developed to yield materials with bright colors and unique optical properties. For example, layering responsive polymers one on top of another, or embedding a responsive polymer layer between two thin reflective layers, can also yield properties akin to colloidal crystalline arrays. Diffraction gratings can also be made into holographic materials, and exploited for sensing applications. Other well-known plasmonic effects have been used extensively for sensing applications, e.g., the surface plasmon resonance effect that is found with certain metals and metal-based nanoparticles (e.g., Au and Ag). This plasmonic

effect leads to solution color, which can be manipulated by changing the distance between the particles. Systems have been constructed that exploit this distance-dependent solution color for sensing and biosensing. Relatedly, micro-cavities and fiber optics can be combined with the plasmonic effects found in metal films and particles, to yield sensors with very high sensitivity and low detection limits. Leaders in these respective areas have submitted to this volume, which is meant to showcase the breadth of the field and the promise it holds.

Editing this book required extensive work by our respective groups to aid in the organization and review of the chapters. We owe a great deal of gratitude to Dr. Claus Ascheron for allowing us the opportunity to edit this volume, and for his assistance along the way. We also thank Ms. Adelheid Duhm for her assistance with completing this volume.

Canada
Korea, Republic of (South Korea)
Canada

Michael J. Serpe
Youngjong Kang
Qiang Matthew Zhang

Photonic Materials for Sensing, Biosensing and Display
Devices

Serpe, M.J.; Kang, Y.; Zhang, Q.M. (Eds.)

2016, XV, 364 p., Hardcover

ISBN: 978-3-319-24988-9