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Active Photonic Materials VII

Ganapathi S. Subramania
Stavroula Foteinopoulou
Editors

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Introduction

2015 has been proclaimed by the United Nations as “*the International Year of Light and Light-based Technologies*” to celebrate the extra-ordinary technologies we have available in our everyday lives thanks to the progress in the science of light. Light is a key protagonist in overcoming barriers in a vast range of applications, from telecommunications, to medical diagnosis and treatment, to energy management and computing.

To make use of the tremendous potential of light, we must be able to sculpt the landscape of light from the micro- to the nano-scale, while also being able to tame and trap light in time. Research with clever designs of complex structured materials continues to bring about new phenomena and capabilities with light. Pairing such extra-ordinary manmade photonic materials with active or dynamically tunable materials as well as quantum emitters unleashes new unexplored directions.

The Active Photonic Materials VII conference brought together the current developments in this exciting and growing field with new types of EM behaviors and devices being reported. Many exciting talks focused on new paradigms of light amplification, spontaneous emission, and lasing. These were enabled by a vast range of proposed mechanisms, such as by cleverly exploiting judiciously designed plasmonic resonances, exciting slow-light modes, exciting photonic defect states in periodic photonic crystals, and by utilizing light localization in randomly structured media. There were a number of interesting talks that also reported on the developments of new suitable theoretical tools necessary to properly understand and predict the behavior of emitters in these complex EM environments. A growing direction in the field of active photonic materials is that of controlling the system's behavior by utilizing a synergistic interplay between gain and loss that manifests itself in the parity-time (PT) symmetric properties of the system. A number of related fascinating and counterintuitive EM phenomena were presented, such as loss-induced light amplification and lasing.

Inspired by electronic systems, a number of talks also reported photonic states with new non-trivial topologies that are resistant to scattering from defects and can find applications in photonic circuitry and quantum information processing. Quantum information processing has also been the central theme of many engaging presentations reporting exciting new results in controlling the transmission of single photon states, creating entangled photonic states, or photon counting detectors with photonic integrated circuits.

Moreover, there were interesting reports on the progress of fabrication of active photonic environments with controlled incorporation of quantum dots or the incorporation of materials with dynamically tunable properties, such as Al-doped zinc oxide. Last, but not least, several interesting presentations focused on extra-

ordinary tailoring of the absorptive and emissive properties of materials that are relevant to applications, such as energy harvesting, passive radiative cooling, and textiles for personal thermal management.

This year, we also introduced in our conference the *Best Student Paper* competition. We would like to thank all student contributors for the enthusiasm with which they participated in this competition, presenting outstanding and interesting results! The jury committee for this conference award determined three student papers that tied in the first place, which were presented with a SPIE-Best Student Paper award certificate in the closing of the conference. These are:

“*Ultrafast dynamics of Al-doped zinc oxide under optical excitation*” [9546-23], by **Nathaniel Kinsey**, Purdue University (United States) (*presentation only*)
Co-Author(s): Clayton T. DeVault, Jongbum Kim, Purdue University (United States); Marcello Ferrera, Purdue University, (United States), Heriot-Watt University (United Kingdom); Alexander V. Kildishev, Vladimir M. Shalaev, Alexandra Boltasseva, Purdue University (United States)

“*Single mode parity-time laser*” [9546-35], by **Zi Jing Wong**, University of California, Berkeley (United States) (*see paper 95460Z in this proceedings volume*)
Co-Author(s): Liang Feng, Renmin Ma, Yuan Wang, Xiang Zhang, University of California, Berkeley (United States)

“*Improving emission in nanorod arrays using quasi-aperiodic inverse design*” [9546-47], by **P. Duke Anderson**, University of California, Berkeley (United States) (*presentation only*)
Co-Author(s): Michelle L. Povinelli, The University of Southern California (United States)

Active Photonic Materials VII has brought together theorists and experimentalists to exchange state-of-the art results in this rapidly evolving area of research. As conference chairs, we would like to express our sincere thanks to all the participants of the 9546 conference who contributed their presentations as well as manuscripts to make this conference a stimulating and vibrant event.

**Stavroula Foteinopoulou
Ganapathi S. Subramania**