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Photorefractive Materials, Effects, and Applications : A Critical Review, edited by Pochi Yeh, Claire Gu, Proc. of SPIE Vol. 10270 (Vol. CR48), 1027001 · © (1994) 2017 SPIE · CCC code: 0277-786X/17/$18 · doi: 10.1117/12.2285057

Preface

The photorefractive effect has been under extensive investigation for many years. Owing to their unique properties such as real-time response, low-intensity operation, nonlinear energy coupling, and volume holographic capacity, photorefractive materials have become important in optical computing, storage, information processing, interconnections, and neural networks. We are pleased to have leaders and well-known researchers in this field to review previous and current works on photorefractives and discuss practical applications.

The first three papers address several fundamental issues of photorefractive physics including properties of grating diffraction and mutually pumped phase conjugation by Dr. R. Saxena from Rockwell International Science Center and Dr. Q. B. He from University of California at Santa Barbara, respectively, and an interesting comparison between photorefractive crystals and liquid crystal materials by Prof. I.-C. Khoo from The Pennsylvania State University. The next three papers present important development and practical availability of various photorefractive materials. These include an overview of photorefractive tungsten bronze materials by Dr. R. R. Neurgaonkar et al. from Rockwell International Science Center, discussion on recent developments of photorefractive fibers by Prof. L. Hesselink et al. of Stanford University, as well as a report on fixing and infrared response of doped photorefractive $BaTiO_3$ by Prof. T. W. McNamara et al. from the Massachusetts Institute of Technology.

Following the review and discussion on photorefractive physics and materials, there are nine papers on the applications of photorefractive media. As photorefractive holographic storage is becoming closer and closer to practical application, a great deal of attention has been focused on research in this area. Within the nine application papers, three of them address various issues in three-dimensional optical storage. These include research performed by Prof. F. T. S. Yu et al. from The Pennsylvania State University, Prof. S. H. Lee et al. from University of California at San Diego, and Dr. C. Alves et al. from Institut d'Optique Théorique et Appliquée.

Optical neural networks are also an attractive topic. Prof. D. Psaltis et al. from the California Institute of Technology, and Dr. E. G. Paek from Bell Communications Research give two excellent presentations on optical neural networks. In addition, traditional image processing techniques combined with the applications of photorefractive materials provide the ability of real-time operation. Examples of image processing are given by Prof. K. Hsu et al. from

National Chiao Tung University, and Dr. L.-J. Cheng (Jet Propulsion Laboratory) et al. Two of the nine application papers describe some of the important works conducted at Rockwell International Science Center, i.e., optical interconnections by Dr. A. E. Chiou and acoustic signal processing by Dr. J. H. Hong.

Although a wide range of previous and current research effort has been included in this critical review, there are still many important and interesting works that are not covered here. We hope that continuing development in materials and configurations will make photorefractive nonlinear optics even more important to practical applications.

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