Metastructured Optics Progress and Applications

Connie J. Chang-Hasnain

Abstract

Vertical cavity surface emitting lasers (VCSELs) have long been predicted as low-cost enabling laser sources for many applications including optical communications, sensing and imaging. Traditional VCSELs use distributed Bragg reflectors (DBRs) as mirrors, which consist of many tens layers of epitaxy layers with alternating refractive indecies. Snice 2004, we develeoped a new class of planar optics has emerged using near-wavelength dielectric structures, known as high contrast metastructures (HCM). Many extraordinary properties can be designed top-down based for integrated optics on a silicon or GaAs substrate. The one-dimensional version, a single layer high index contrast near-wavelength gratings (HCG), has been used to replace the hundred-layered DBR in a VCSEL structure. In this talk, I will review recent results using HCG/HCM in device applications of VCSELs, beam-steering optical phased array, biosensor, 4-wave generation, and spatial light modulator. I will discuss inventions and advances in VCSELs that have led to recent global deployment of commercial applications including 3D sensing, LIDAR and optical coherent tomography applications. I will also discuss future prospects for advanced applications.

Biography

Connie Chang-Hasnain is Chairperson of Berxel Photonics and Whinnery Chair Professor Emerita at the University of California, Berkeley. She was Whinnery Distinguished Chair Professor in Electrical Engineering and Computer Sciences (2006-2020), Associate Dean for Strategic Alliances of College of Engineering (2014-2019) and Chair of the Nanoscale Science and Engineering Graduate Group at the same university (2006-2017). Prior to joining the Berkeley faculty, Dr. Chang-Hasnain was a member of the technical staff at Bellcore (1987–1992) and Assistant/Associate Professor of Electrical Engineering at Stanford University (1992–1995). She is a fellow of IEEE, OSA and IEE. She is member of the US National Academy of Inventors and National Academy of Engineering.

Professor Chang-Hasnain's research interests include semiconductor optoelectronic devices, materials and applications. She pioneered the first planar VCSEL structure using proton implantation for array fabrication with Gbps modulation, first MEMS-VCSEL for wavelegnth tuning, and the first 1000-elecment VCSEL arrays for 3D imaging. Prof. Chang-Hasnain has been honored with many awards including the Okawa Prize (2018), UNESCO Medal For the Development of Nanoscience and Nanotechnologies (2015), IEEE *David Sarnoff Award* (2011), and the OSA *Nick Holonyak Jr. Award* (2007). Additionally, she has been awarded with a *Vannevar Bush Faculty Fellowship*, a *Humboldt Research Award*, and a *Guggenheim Fellowship*. She was a member of IEEE LEOS Board of Governors, OSA Board of Directors, and the Board on Assessment of NIST Programs, National Research Council. She was the Editor-in-Chief of Journal of Lightwave Technology 2007-2012. Professor Chang-Hasnain is the OSA President in 2021.