Citation

For pioneering and outstanding research of VCSEL photonics through the development of their novel functions for optical communications and optical sensing

Dr. Constance Chang-Hasnain

Positions and Organizations :
Associate Dean for Strategic Alliances, College of Engineering
John R. Whinnery Distinguished Chair Professor, Electrical Engineering and Computer Sciences
Co-Director, Tsinghua-Berkeley Shenzhen Institute
Chief Academic Officer, Berkeley Education Alliance for Research in Singapore
University of California, Berkeley

Degree : Ph.D. in Electrical Engineering and Computer Science, (UC Berkeley, 1987)

Date of Birth : October 1, 1960

Brief Biography :
1982 B.S. in Electrical and Computer Engineering, UC Davis
1984 M.S. in EECS, UC Berkeley
1987 Ph.D. in EECS, UC Berkeley
1987-1992
Member of Technical Staff, Bell Communications Research (Bellcore)
1992 Assistant Professor of EE, Stanford University
1995 Associate Professor of EE, Stanford University
1996 Professor, EECS UC Berkeley
1998-2000
Founder, CEO, CTO and Chairman, Bandwidth9 Inc.
2006-2017
Chair, Nanoscale Science and Engineering Graduate Group, UC Berkeley
2006-Present
John R. Whinnery Distinguished Chair Professor of EECS, UC Berkeley
2010 Co-founder, Chief Scientist, Bandwidth10 Inc.
2014-Present
Associate Dean, College of Engineering, UC Berkeley
2015-Present
Founding Co-Director, Tsinghua-Berkeley Shenzhen Institute

Main Awards and Honors:
1992 Outstanding Young Electrical Engineer Award, Eta Kappa Nu Honor Electrical Engineer Society
1992 National Science Foundation National Young Investigator Award
1992 Packard Fellow, David and Lucile Packard Foundation
1993 Young Alumnus of the Year, UC Davis
1994 Alfred P Sloan Research Fellow
1994 Presidential Faculty Fellow, White House
2003 IEEE William Streifer Scientific Achievement Award
2005 National Academy of Engineering Gilbreth Lecturer
2005 Honorary Member, A. F. Ioffe Institute, Russia
2007 OSA Nick Holonyak, Jr. Award
2008 DoD Vannevar Bush Faculty Fellowship
2009 Guggenheim Memorial Foundation Fellowship
2009 Humboldt Research Award, Alexander von Humboldt Stiftung Foundation
2009 Microoptics Award, Microoptics Conference (MOC), The Japan Society of Applied Physics
2011 IEEE David Sarnoff Award
2013 Outstanding Research Award, Pan Wen Yuan Education Foundation
2014 Quantum Device Award, International Symposium on Compound Semiconductor
2015 UNESCO Medal for the Development of Nanoscience and Nanotechnologies

Member of National Academy of Engineering, Fellow of Optical Society of America (OSA), IEEE and IEE

Main Achievements :

Over the past three decades, Dr. Constance Chang-Hasnain made seminal contributions to the physics, design, materials and applications of Vertical Cavity Surface Emitting Lasers (VCSELs) that help establish VCSELs as the dominant technology for multimode fiber applications, optical coherent tomography, and 3D sensing.

Dr. Chang-Hasnain began to work on VCSELs and laser arrays in 1988 during the infancy of VCSEL photonics. She published the first comprehensive theoretical and experimental studies on VCSEL modal properties, which provided VCSEL design guidelines. She suggested the first planar VCSEL structure using proton implantation for high performance array fabrication with Gbps modulation. This design became part of industry standard for VCSEL fabrication. In addition, she published the first Gbps multi-mode (MM) VCSEL transmission using MM fiber, which became the dominant commercialized transmitter for datacenter communications.

She contributed many original concepts on VCSEL arrays. She showed that VCSELs can be used for wavelength-division multiplexing applications with the first demonstration of 140-wavelength VCSEL array. She pioneered the first 940-nm wavelength, 1000-element VCSEL arrays for 3D sensing in 1998. These work led the way for the optical fiber short-wave division multiplexing (SWDM) systems and optical projectors in facial recognition applications.

Dr. Chang-Hasnain's invention and integration of Micro-Electro-Mechanical Systems (MEMS) and photonic systems created a new class of optoelectronic devices. The ability to continuously tune the frequency of an oscillator is critical importance and is a fundamental building block for many systems. This very important basic function has been very challenging for lasers. She invented MEMS-VCSEL as a widely wavelength tunable and sweptable laser in 1994. By making one of the mirrors in a vertical cavity into a movable arm, the laser wavelength can be continuously swept. The MEMS-VCSEL is the only wavelength-tunable laser design that can provide simultaneously a fast sweep rate over a wide range. Such characteristic enables swept-source coherent optical tomography (SS-OCT), leading to high-resolution over a larger field of view and makes possible observations of features that were not attainable otherwise. The impact of this body of work can be seen in a vast number of applications today, including SS-OCT for ophthalmology, dermatology, cardiology, and gastroenterology; wavelength division multiplexed (WDM) datacenter fiber communications; biomedical and pharmaceutical analysis, and sensing applications.

Dr. Chang-Hasnain invented a new class of flat, ultra-thin optics using near-wavelength gratings, referred as high-contrast gratings (HCG) or high contrast metastructures (HCM), in 2003. This seemingly simple structure lends itself to extraordinary properties, which can be designed top-down based for integrated optics on a silicon substrate. The extraordinary features include an ultra broadband high reflectivity reflector, a high quality-factor resonator and phase control elements. Using HCG to replace the traditional distributed Bragg reflector on a VCSEL, Dr. Chang-Hasnain greatly improved MEMS-VCSEL sweep range and speed, and demonstrated a continuously tunable, directly modulated tunable 1550-nm VCSEL for datacenter network, LiDAR (3D imaging) and fiber-to-the-home applications.

Recently, Dr. Chang-Hasnain has expanded HCM towards many other flat optics applications, including optical lens, beam dividers, surface-normal optical modulator, optical biosensor, optical beam scanner, optical frequency multiplier, hologram etc. Most recently, Dr. Chang-Hasnain demonstrated a thin-HCM-film that can be made to change color on demand by simply applying a minute amount of force, referred as artificial chameleon-skin. It offers intriguing possibilities for new display technologies, color-shifting camouflage, and sensors. The field of HCG has seen rapid advances in both experimental demonstrations and theoretical results. Dr. Chang-Hasnain founded a new conference on this topic since 2012, which is held annually at SPIE Photonics West.

Dr. Chang-Hasnain has been an active volunteer and has served different positions in Optical Society of America (OSA), IEEE Photonics Society and SPIE. She chaired many professional conferences including the Microoptics Conference 2016. She was the Editor-in-Chief of the IEEE/OSA Journal of Lightwave (2007-2012), elected Director-at-Large on the OSA Board of Directors (1998-2000), and member of the OSA Centennial Advisory Panel (2014-2016). She was a member of the US Air Force Scientific Advisory Board, IEEE Photonics Society Board of Governors and the US National Research Council' s Board on Assessment of NIST Programs, Study on Optics and Photonics, and US Advisory Committee to the International Commission on Optics. Dr. Chang-Hasnain has been elected the 2019 OSA Vice President and will serve as OSA President in 2021.

For pioneering research and development of VCSEL photonics through inventions and advances of their novel functions for optical communications and optical sensing, Dr. Constance Chang-Hasnain is hereby awarded the Okawa Prize.