

IEEE Photonics Society Special Seminar in Conjunction with UNM's OSE

Engineerable Phased-Array Sources Based on Nonlinear Metamaterial Nanocavities

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Date: Tuesday, November 10, 2015 at Noon.

Location: UNM, CHTM Building, Room 101.

Pizza and Refreshments will be served.



Abstract: We propose a new concept for phased-array sources at infrared frequencies based on the second harmonic generation capacity of metamaterial nanocavities strongly coupled to a highly nonlinear semiconductor heterostructure comprising intersubband transitions in quantum wells (QWs). This system is attractive for the manipulation of the direction, shape, and polarization of optical beams. The metamaterial nanocavity is designed to support both a fundamental resonance and an orthogonally polarized resonance at the second harmonic frequency. The asymmetric QW structure is designed to provide a large second order susceptibility. Optical pumping of the nanocavity induces a localized, phase-locked, nonlinear resonant polarization that acts as a source feed for a higher order resonance of the nanocavity. Varying the nanocavity design enables the production of beams with arbitrary shape and polarization. Due to the sub-wavelength extent of our QW structure, we are not limited by phase matching conditions as one would have for a conventional nonlinear crystal. Upon continuous wave illumination at the fundamental frequency we observe second harmonic signals in both the forward and backward directions. We achieve very efficient overall second harmonic generation given the deep sub-wavelength dimensions of the QW structure (at mid-infrared, about 1/15th of the free space wavelength of 10 μm). We also demonstrate two second harmonic phased-array sources that perform two optical functions at the second harmonic wavelength ($\sim 5 \mu\text{m}$): a beam splitter and a polarizing beam splitter. Such systems represent a viable strategy for designing easily fabricated phased-array sources across the entire infrared spectrum through proper choice of QW and nanocavity designs.

Biography: Salvatore Campione received a Laurea Triennale degree (cum laude) and a Laurea Magistrale degree (cum laude) in electronic engineering from the Polytechnic of Turin, Italy, in 2007 and 2009, respectively. He also received a Master of Science degree in electrical and computer engineering from the University of Illinois at Chicago, IL, USA, in 2009, and a Doctor of Philosophy degree in electrical and computer engineering from the University of California Irvine, CA, USA, in 2013. He was a visiting scholar at the U.S. Army Charles M. Bowden Research Center, RDECOM, Redstone Arsenal, AL, USA in 2012 and at Sandia National Laboratories, Albuquerque, NM, USA in 2012 and 2013. He joined Sandia National Laboratories in 2014, where he is currently a Postdoctoral Appointee. He has published more than 45 peer-reviewed journal articles, more than 75 conference papers, 1 provisional patent, and 2 book chapters. His research interests fall in the general area of applied electromagnetics, including electromagnetic analysis and modeling of complex structures, antenna radiation, computational electromagnetics, metamaterials, plasmonics, nanophotonics, and optical devices for energy and optoelectronic applications. Among other awards, he has been selected as a 2013 Marconi Society Paul Baran Young Scholar (3 awarded each year worldwide), recognizing his academic achievements and leadership in the field of communications and information science.

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