University of Victoria | Graduate Studies

Notice of the Final Oral Examination for the Degree of Doctor of Philosophy

of

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"Plasmonic Metasurfaces for Enhanced Third Harmonic Generation"

Department of Electrical and Computer Engineering

Wednesday, September 7, 2016
10:00 A.M.
Engineering and Computer Science Building
Room 468

Supervisory Committee:
Dr. Reuven Gordon, Department of Electrical and Computer Engineering, University of Victoria (Supervisor)
Dr. Harry Kwok, Department of Electrical and Computer Engineering, UVic (Member)
Dr. Byoung-Chul Choi, Department of Physics and Astronomy, UVic (Outside Member)

External Examiner:
Dr. Xiaojin Jiao, Process Engineer, Intel Corporation

Chair of Oral Examination:
Dr. Mohsen Akbari, Department of Mechanical Engineering, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

This research was mainly focused on the design and optimization of aperture-based structures to achieve the greatest third harmonic conversion efficiency. It was discovered that by tuning the localized surface plasmon resonance to the fundamental beam wavelength, and by tuning the propagating surface plasmons resonance to the Bragg resonance of the aperture arrays, both the directivity and conversion efficiency of the third harmonic signal were enhanced. The influence of the gap plasmon resonance on the third harmonic conversion efficiency of the aperture arrays was also investigated. The resulted third harmonic generation (THG) from an array of annular ring apertures as a closed loop structure were compared to arrays of H-shaped, double nanohole and rectangular apertures as open-loop structures. The H-shaped structure had the greatest conversion efficiency at approximately 0.5 %. Moreover, it was discovered that the maximum THG did not result from the smallest gap; instead, the gap sizes where the scattering and absorption cross sections were equal, led to the greatest THG. The finite difference time domain (FDTD) simulations based on the nonlinear scattering theory were also performed. The simulation results were in good agreement with the experimental data. Moreover, a modified quantum-corrected model was developed to study the electron tunneling effect as a limiting factor of the THG from plasmonic structures in the sub-nanometer regime.