

## Scheduling of Examination

Student's Name: Sajid Choudhury  
Degree: Doctor of Philosophy  
Type: Final Exam

Major Professor: ALEXANDRA BOLTASSEVA, Co-chair  
Advisor 1: ALEXANDER V KILDISHEV, Co-chair  
Advisor 2: VLADIMIR M SHALAEV  
Advisor 3: XIANFAN XU  
Advisor 4: ALI SHAKOURI

Examination Date: 07-08-2019  
Examination Time: 2:00 PM  
Building & Room: BRK 1001

Thesis Title: Wavefront Manipulation with Metasurfaces based on New Materials

Abstract: Metasurfaces, introduced as a compact 2D alternative of metamaterials, has developed into a vast field in recent times for light manipulation at an ultra-compact scale. Metasurface applications have found a place in the literature for compact alternatives to lens, holograms, polarizers, color filters. Plasmonic metasurfaces consisting of noble metals such as gold and silver provide light confinement on an unprecedented scale. Gold and silver grown conventionally on transparent substrates are polycrystalline, and exhibit losses and limit performance of the device. Moreover, they have a lower damage threshold and melting point. To circumvent the lower melting point and damage thresholds, new materials, and material growing techniques need to be researched.

In the first part of this work, a metasurface for color holography with an epitaxially grown silver thin film on a transparent substrate is shown. The demonstrated metasurface has been the first ever epitaxial silver metasurface that operated in the transmission mode. This plasmonic hologram has also been the thinnest metasurface hologram operating in

transmission mode at the time of its reporting. The holographic image of all three basic color components of red, green, and blue has been demonstrated in the transmission mode. The control of color has been achieved by resonant sub-wavelength slits and the phase can be manipulated through altering slit orientation. This amplitude and phase control paves the way to applications of ultra-compact polychromatic plasmonic metasurfaces for advanced light manipulation. In the second part, we explore temperature rise due to the optical absorption in plasmonic structures. Titanium Nitride based metasurfaces structures are fabricated, that work in harsh environmental conditions and high temperature. A time domain thermo reflectance technique for rapid measurement of temperature is explored. Finally, a practical design prototype for thermo-photovoltaic (TPV) emitters using plasmonic metasurfaces is fabricated and characterized.