Department of Electrical and Computer Engineering

North South University

Senior Project Design Report

EEE 499

"Near Field Optical Pulling Force on Plasmonic and Dielectric Nanoparticles Between Two Glass Substrates Using Plane Wave"

Submitted by

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Declaration

This is to declare that no part of this report or the project has been previously submitted elsewhere for the fulfillment of any other degree or program. Proper acknowledgment has been provided for any material that has been taken from previously published sources in the bibliography section of this report.

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Approval

The Senior Design Project entitled “Near Field Optical Pulling Force on Plasmonic and Dielectric Nanoparticles Between Two Glass Substrates Using Plane Wave” by Md. Tarikul Islam (ID: 1621448043) and Mashiyat Khan (ID: 1621327043) has been accepted as satisfactory and approved for partial fulfillment of the requirement of BS in EEE degree program.

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Acknowledgment

First of all, we wish to express our gratitude to the Almighty for giving us the strength to perform our responsibilities and complete the report. It is imperative to show our appreciation for our honorable faculty member Dr. Mahdy Rahman Chowdhury for his undivided attention, meticulous supervision, guidance, valuable suggestions, patience, and thorough encouragement to complete this research. Also, we are grateful to receive the facility of a powerful PC from NSU Optics Lab that helps us to conduct our research. Moreover, we would like to thank the research assistants of Mahdy sir for their constant support, help, and encouragement. We also thank our friends and family for their moral support to carve out this project and always offer their support.

ABSTRACT

Optical pulling is getting huge attention in the optical manipulation field for its unique applications. Many tried to give their contribution to getting a good OPF over different particles. This technique is very popular from kid to scientist as an image of taking things into the spaceship using light comes to mind whenever we heard about OPF or tractor beam. We showed a tremendous way to get OPF in this report named, **"Near Field Optical Pulling Force on Plasmonic and Dielectric Nanoparticles Between Two Glass Substrates Using Plane Wave"** where we used two glass substrates in the homogeneous medium. We used COMSOL MULTIPHYSICS to calculate all the data and investigate different physics like electric field distribution, current density, arrow line, pointing vector, etc. We used two features of COMSOL MULTIPHYSIC named Multislice and Arrowline to investigate the physics working behind our research. We take an Airbox as the background medium and set all the necessary boundary conditions in the outer surface of the airbox. Inside the Airbox, two glass substrates have been placed and nanoparticles are put into them to find out the light-matter interaction. We projected a plane wave from the X direction where the electric polarization is set along the Y direction and magnetic polarization in the Z direction. In our setup, we used varying lambda (λ) as parametric sweep. Physics-defined mesh has been used and a slightly larger surface has been used for surface integration to calculate the force along every direction. We used gold and silver as plasmonic nanoparticles and silicon dioxide as dielectric nanoparticles in our experiment. We use two different sizes for investigation and come out with a good result. In short, our work is to see the light-matter interaction for the plan wave and how the interaction changes concerning the wavelength of the light.