TET Student Project

Investigation of optical surface states in graphene-dielectric lattices

Project introduction:

It has been found that the termination of periodic materials induces various light states at material surfaces, which are distinguished from those in perfect periodic or bulk materials. Surface waves, including linear and nonlinear waves, can be supported by the terminated dielectric/plasmonic lattices, with the possibility of the non-diffractive evolution along the lattice surfaces. In the linear regime, the most common surface modes are Tamm states [1] and Shockley states [2], being regarded as the direct analogues of the concept in solid physics. In the nonlinear regime, surface solitons occur when the light intensity rises above a threshold [3]. The generation and control of these surface states are thus investigated under a consideration of revealing their physical nature and also being applied for the photonic elements. As a novel 1-dimensional integratable material, graphene sheets can be compiled with metal/dielectric to build compact optical lattices. It is thus expected that surface modes could also be found in such structures, by employing a suitable geometric termination, which may bring interesting phenomena and properties.

Tasks and goals:

This project will numerically design and analyze graphene-based photonic lattices with truncations, which are used to supported surface states. The major goal is to discover the existence condition and the physical properties. Empirical material parameters and energy loss will be considered during the design and optimization process. The project will be executed using commercial software Comsol Multiphysics, with some aided programming work and is scheduled for one semester.

Requirements:

1. Prior knowledge (undergraduate level) of Optics/Electromagnetic fields.
2. Basic Matlab programming skills.

References:

[1]. H. Ohno, et.al., Phys. Rev. Lett. 64, (1990).
[2]. N. Malkova, et.al., Opt. Lett., 34, 11 (2009).
[3]. Ivan Iorsh, et.al., Phys. Status Solidi RRL 6, 1 (2012).

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