Emission Characteristics of Solid State Color Centers Coupled to Plasmonic Antennae and Waveguides

M. Y. Shalaginov[1], S. Bogdanov[2], A. V. Kildishev[2]

[1]Massachusetts Institute of Technology, Cambridge, MA, USA
[2]Purdue University, West Lafayette, IN, USA

Abstract

Recently a lot of research efforts have been focused on using plasmonics and nanophotonic structures for enhancing emission processes ranging from lasing to single-photon generation. The design of such structures heavily relies on the insight obtained from numerical simulations. In this context, the key challenge is to accommodate a multi-order difference in scales present in the simulated models. In this work we discuss the use of COMSOL Wave & Optics Module for simulating the emission of color centers in nanodiamond crystals coupled to nanocube-patch antenna and channel plasmonic waveguides. The calculated emission characteristics include far-field radiation pattern, total dissipated power, coupling efficiency to waveguide modes and ohmic losses, but can be straightforwardly extended to other relevant quantities. The numerically obtained results were compared with the semi-analytical calculations based on Dyadic Green function formalism. These COMSOL simulations allowed us to experimentally implement ultra-bright single-photon sources and demonstrate functionality of an on-chip integrated spin-plasmon-microwave interface.