Magnetic Field Enhancement using Nanotoroid Antenna Array

Magda El-Shenawee[(1)] and Renaud Bachelot[(2)]
(1) Department of Electrical Engineering
University of Arkansas, Fayetteville, AR 72703
(2) Université de Technologie de Troyes
12 Rue Marie Curie - BP 2060 -10010 Troyes Cedex – France

This work aims to investigate the capability of nanotoroid array of antennas for the purpose of magnetic field enhancement. Several works have been published to study the electric field enhancement of similar nanostructures (A. Mary *et al*, *Physical Review* B. 76, 245422-(1-5) 2007, M. A. Suarez *et al*, *Optics Communications*, 447-545, 2007, and M. El-Shenawee *et al*, *IEEE APS*, 2009). Since the nanotoroid resembles the magnetic dipole, the idea is to study the capability of this particular nanoantenna to enhance the magnetic field inside the cavity. In addition, circular, linear, and azimuth incident polarizations could influence the hot spots of the near magnetic fields. These types of polarizations will be investigated and a comparison will be conducted to demonstrate the magnetic and electric fields in each case. The size of the nanotoroid and the number of elements considered in the array will be investigated as well.

The method of moments surface integral equation (MoM/SI) is employed to calculate the near and far fields of the gold nanotoroid array. The optical properties of the gold at the visible light will be used (P. B. Johnson and R. W. Christy, *Phys. Rev. B*, v. 6, no. 12, 1972). Toroids with variation rations between the inner and outer radii in nanometers will be investigated. Three types of polarizations of the incident plan waves will be considered; linear, circular, and azimuth (M. A. Suarez *et al*, *Optics Communications*, 447-545, 2007). The nanotoroid array will be designed to control the magnetic or the electric field enhancement inside the toroid's cavity.

The extinction coefficients, magnetic and electric near fields, and surface current densities will be demonstrated versus the incident polarizations and the array design.