Artificial magnetic nanostructures: isolated metal/insulator/metal nanodot arrays with transmission geometry

Thanh Son Vo[1,*], Byong-Guk Park[2], Jong-Ryul Jeong[1]
[1]Graduate School of Energy Science and Technology, Department of Materials Science and Engineering, Chungnam National University, Daejeon 305-764, South Korea
[2]Department of Materials Science and Engineering, KI for the Nanocentury, KAIST, Daejeon 305-701, South Korea

In this study, we have systematically investigated a magnetic resonance absorption and tunability of absorption wavelength in isolated metal-insulator-metal (MIM) nanodot arrays with transmission geometry. The elemental electromagnetic resonances and their hybridizations are studied using 3-dimensional finite-difference time-domain (FDTD) calculation and resonance properties including the resonance peak tunability, magnetic permeability and quality (*Q*) factor are characterized with respect to the coupling strength. We have found the existence of electric and magnetic resonance mode in the MIM (Au/MgF_2/Au) structure and the magnetic resonance has larger wavelength tunability than the electric resonance. The absorption cross section calculation revealed that absorption is the dominant extinction process at the magnetic resonance only. Magnetic permeability (μ) calculations for the various MIM parameters showed the maximum value of the imaginary part of μ is 16.1 with *Q* factor of 9.2 when the size of nanodot is 200 nm and the inter-dot distance is 300nm. The presented calculations can be used to tune the response of the magnetic resonance absorption with a variable resonance wavelength and *Q* factor by using the simple MIM structures with transmission geometry.

Keywords: metal/insulator/metal structure, magnetic absorption, magnetic permeability, magnetic resonance, nanodot arrays