Magnetic Fano resonance in three dimensional metamolecule.

Wei-Yi Tsai[1*], Pin Chieh Wu[1], Wei Ting Chen[1], Kuang-Yu Yang[1], Chih Ting Hsiao[1], Greg Sun[2], Ai Qun Liu[3], Nikolay I. Zheludev[4] and Din Ping Tsai[1,5]

[1]Department of Physics, National Taiwan University, Taipei 10617, Taiwan
[2]Department of Physics, University of Massachusetts Boston, MA 02125 , USA
[3]School of Electrical and Electronic Engineering, Nanyang Technological University, 639798, Singapore
[4]Optoelectronics Research Centre and Centre for Photonic Metamaterials, University of Southampton, Southampton SO17 1BJ , UK
[5]Research Center for Applied Sciences, Academia Sinica,Taipei 11529, Taiwan
* E-mail: d03245001@ntu.edu.tw

In quantum system, electromagnetically induced transparency (EIT) is generated when a continuous state couples to a discrete state resulting in quantum interference that provides a transmission peak within a broad absorption profile [1]. In the field of plasmonic metamaterials, the sub-wavelength metallic structures play a role similar to atoms in nature. Plasmon induced transparency (PIT) arises from the interference of their near-field coupling at plasmonic resonance that is analogous to the EIT of quantum systems [2]. A sensitive control of the PIT is crucial to a range of potential applications such as slowing light and biosensor. Here we report the first three dimensional photonic metamaterial consisting of an array of erected U-shape [3] plasmonic gold nanostructures (Fig.1) that performs PIT phenomenon with magnetic dipolar interaction between magnetic metamolecules. By using numerical simulation, we further investigate the coupling phenomenon between the different excited pathways at an intermediate resonant wavelength allows for a π phase shift resulting in a destructive interference.

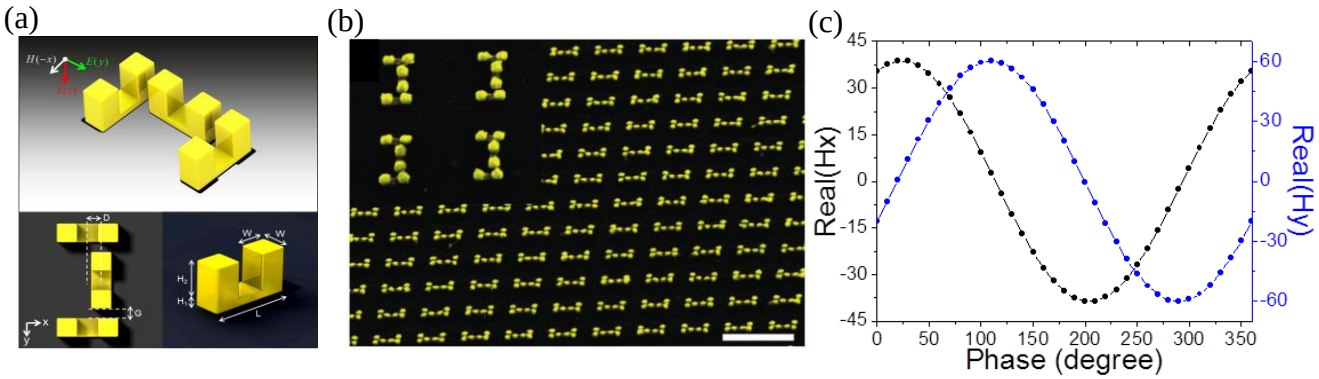

Figure 1. (a) Schematic of Vertical Split-Ring U-shaped. (b) SEM image of erected U-shape. (c) Simulation result of coupling effect inducing the phase shift.

[1] S. E. Harris et al., Phys. Rev. Lett. 66, 2593 (1991)
[2] X. Zhang et al., Phys. Rev. Lett. 101, 047401 (2008)
[3] P. C. Wu et al., Nanophotonics 1(2), 131-138 (2012).