Electronic Supplementary Material (ESI) for Nanoscale.
This journal is © The Royal Society of Chemistry 2015

Supplementary Information

For

Double Fano resoances in plasmonic nanocross molecules and magnetic plasmon propagation

Guo-Zhou Li,[a] Qiang Li[b] and Li-Jun Wu*[a]

[a]*Guangdong Provincial Key Laboratory of Nanophotonic Functional Materials and Devices, School of Information and Optoelectronic Science and Engineering, South China Normal University, Guangzhou 510006, P.R. China. E-mail: ljwu@scnu.edu.cn*

[b]*Department of Physics, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, P.R. China.*

1. The influence of the dimension of the structure

As we know, the intrinsic loss of the metal (Au in our case) is proportional to the imaginary part of the refractive index. It increases with an increase of the wavelength in the near infrared spectral range.[S1] If we decrease the operating wavelength, the non-radiative loss of Au is decreased. In addition, with the dimension of the structure is decreased, the radiative losses could be decreased. Figure S1 shows the results with an operating wavelength of 1600 nm. As seen, the field decay length can reach up to 2.787 μm by scaling down the structure.

2. The influence of the excitation

Figure S2 shows the results when the linear chain structure is excited by a magnetic dipole source placed in the center of the leftmost tetramer, which is similar to that in the structure proposed by Liu *et al.*[S2] The field decay length can reach up to 3.767 μm. The higher value of the magnetic dipole excitation compared to that of the electric dipole excitation (as shown in the main text) is likely to be due to the symmetry of the excitation configuration and the lower radiation losses of the magnetic dipole.[S3]

(a)

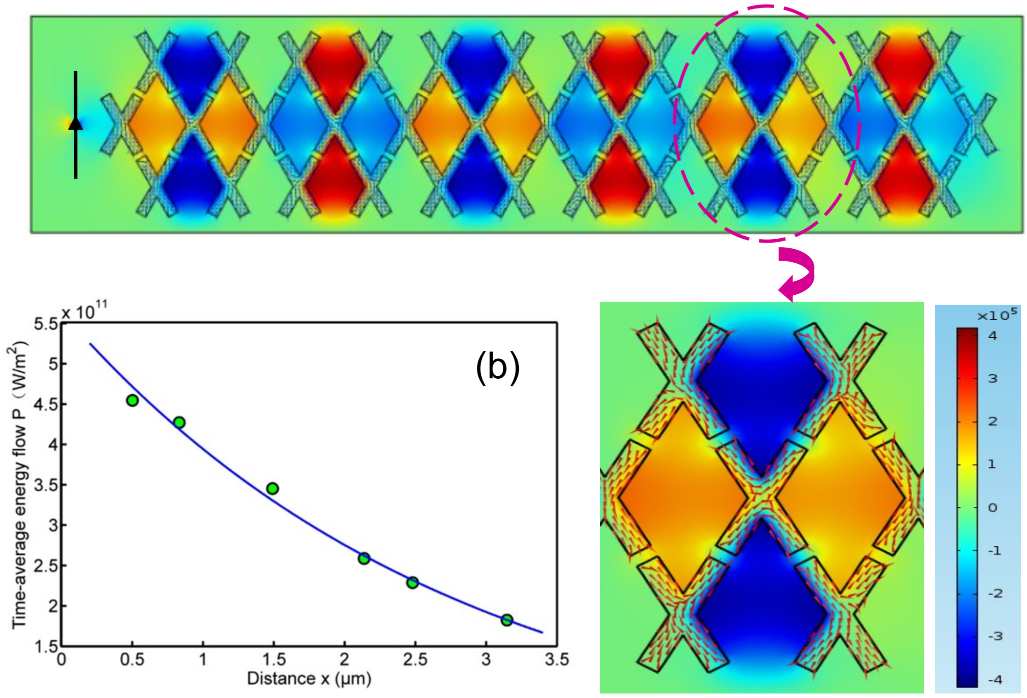

Figure S1 (a) Magnetic field plots superimposed with current vector distributions of a coupled chain with twelve tetramer units at a magnetic resonant wavelength of 1600 nm using a electric dipole excitation source. The dipole source with an amplitude of 1×10^{-9} mA is placed at a distance of 150 nm from the left end of the chain (indicated by the dark arrow line). The size of the nanocross is scaled down compared to that in the main text. The geometrical parameters are: l = 300 nm, W = 50 nm, H = 30 nm, α = 60° and S = 30 nm. The bottom inset shows a zoomed-in part to clarify the current vectors. (b) The energy flow as a function of the distance along the chain. The fitted energy flow equation is $P = 5.6438 \times 10^{11} \exp(-x/2.787)$, corresponding to a field decay length of 2.787 μm.

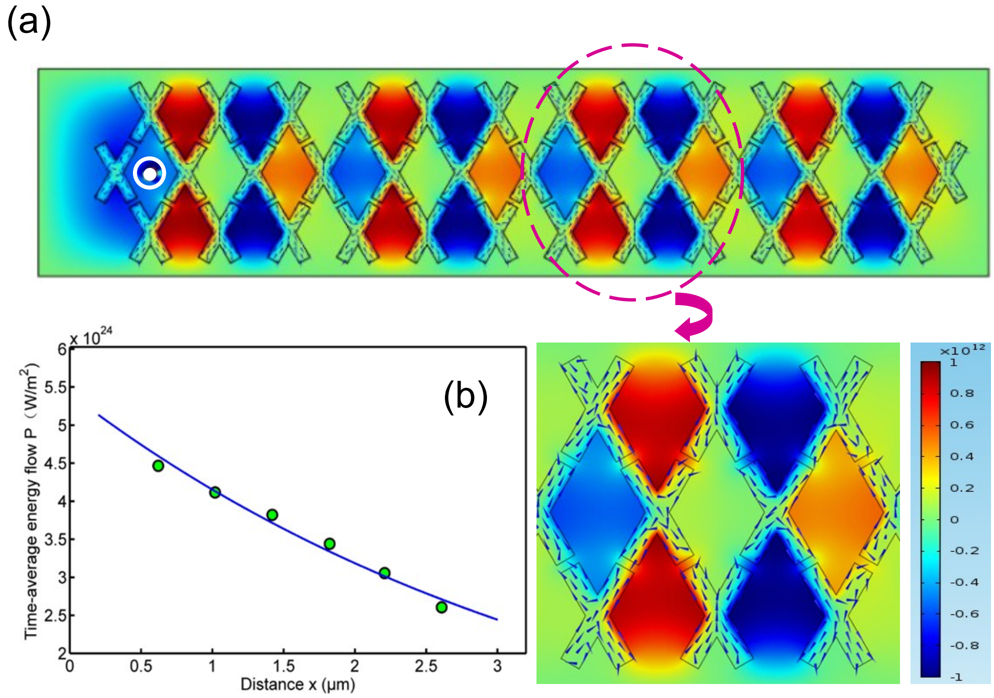

Figure S2 (a) Magnetic field plots superimposed with current vector distributions of a coupled chain with twelve tetramer units at the magnetic resonant wavelength (2030 nm) using a magnetic dipole excitation source. The dipole source with an amplitude of 1×10^{-9} m^2A is placed in the center of the leftmost tetramer (indicated by a white concentric circle). All the geometrical parameters are the same as those in the main text. The bottom inset shows a zoomed-in part to clarify the current vectors. It is noted that the color bar is different from the above. (b) The energy flow as a function of the distance along the chain. The fitted energy flow equation is $P = 5.4149 \times 10^{24} \exp(-x/3.767)$, corresponding to a field decay length of 3.767 μm.

Supplementary Information References

S1. P. B. Johnson and R. W. Christy, *Phys. Rev. B*, 1972, **6**, 4370–4379.

S2. N. Liu, S. Mukherjee, K. Bao, Y. Li, L. V. Brown, P. Nordlander and N. J. Halas, *ACS Nano*, 2012, **6**, 5482–5488.

S3. J. D. Jackson, *Classical Electrodynamics*, John Wiley & Sons, Inc., 1999.