Mapping and control of ultrafast plasmons with PEEM

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Synopsis Plasmon resonance assisted strong near field enhancement has attached great attention in various fields. In this presentation, we demonstrate subwavelength imaging and control of the localized near-field distribution under resonant and off-resonant excitation of identical gold bow-tie nanostructure through photoemission electron microscopy (PEEM). The underline physics of localized surface plasmon (LSP) of nanostructure under these two excitation schemes are revealed. Dynamics evolution of LSP in the nanostructure is unraveled by using a combination of fs pump-probe technique with PEEM. We also present theoretically investigation of the optical response of asymmetric nanocross and a coupled ring dimer-rod nanosystem under ultrafast laser illumination in this work.

Plasmon resonance assisted strong near field enhancement has attached great attention in various fields. On one hand, effort has been made to pursuit resonant field enhancement in the research of excitation and control of localized surface plamsons (LSP). On the other hand, off-resonant excitation of LSP in nanostructure is also found to have great potential in some fields, e.g. biomedicine.

We demonstrate subwavelength imaging and control of the localized near-field distribution under resonant and off-resonant excitation of identical gold bow-tie nanostructure through photoemission electron microscopy (PEEM). The results show that the near field can be controlled and a better control effect is achieved for the resonant excitation than the case of off-resonant excitation[1]. Furthermore, we have found that phase of the localized near field goes inverted after its position shift for the single pulse control scheme, while the phase keeps unchanged after position shift for the two orthogonally pulses control. To study the temporal evolution of the ultrafast plasmons, the LSP in bowtie structure is imaged by a pair of ultrafast femtosecond laser pulses. The results show that by combining the pump-probe technology with PEEM, a series of images of LSP modes temporal evolution on different tips of the bowtie are obtained [2]. We also present theoretically investigation of the optical response of asymmetric nanocross and a coupled ring dimer-rod nanosystem under ultrafast laser illumination in this work [3].

These works open the way for the applications of ultrafast plasmon such as in the field of ultrafast optical switching.

References

[1] *B. Ji et al.* 2016 *New Journal of Physics* **18** 093046
[2] *J.Qin et al. 2015 Chin. Phys. Lett.* **32** 064202
[3] *B. Ji et al. 2015 Plasmonics* **10** 1573

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