Surface plasmon mediated high capacity information technology

Xiangping Li

Institute of Photonics Technology, Jinan University, Guangzhou, P.R.China

E-mail: xiangpingli@jnu.edu.cn

Surface plasmons (SPs) propagating along the interface between metals and dielectrics are capable of tailoring light matter interaction at the nanoscale, which emerges as a research frontier in nanophotonics [1,2]. The advance in nanotechnology has allowed the metallic materials to be structured on the nanometer scale, which in turn has enabled the electrons to respond collectively by oscillating in resonance with light's intrinsic properties such as wavelength and polarization [3,4,5]. The control of SP properties enables to reveal new aspects of their underlying science and to tailor them for specific applications, for instance in nano-optics, heat assisted magnetic recording, high resolution microscopy, sensors as well as energy harvesting [1,2]. In this paper, we introduce the recent progress of high capacity optical information storage and high throughput on-chip information processing mediated by surface plasmons. Through the investigation of polarization-sensitive plasmonic resonance in metallic nanorods and the subsequent photothermal reshaping mechanism, information can be multiplexed in the multiple polarization orientations in the same spatial region [6]. It enables optical recording with orders of magnitude increased capacity as well as security. In addition, we show the throughput of information processing by plasmonic nano-structures can be significantly increased. We investigate the guiding modes in plasmonic nano-apertures consisting of nano-groove and enclosed nano-ring slits. It reveals that the overall transmission of the plasmonic nano-apertures is dependent on the angular momentum of the incident light as well as the geometry of the size of the structure. Employing this unique feature, angular momentum multiplexing at the nanoscale by coaxially superimposed or spatially-shifted nano-apertures with variant sizes can be realized [7]. The non-resonant feature associated with the underlying mode matching mechanism enables the operation at a broad bandwidth over 150 nm. Consequently, information multiplexed in three wavelengths and four angular momentum states can be processed in parallel, leading to an enhanced throughput.

REFERENCES:

[1] W. L. Barnes, A. Dereux and T. W. Ebbesen, "Surface plasmon subwavelength optics," Nature **2003**, 424, 824-830

[2] E. Ozbay, "Plasmonics: Merging Photonics and Electronics at Nanoscale Dimensions," Science. **2006**, 311, 189-193.

[3] K. Kumar, H. Duan, R. S. Hegde, S. C. W. Koh, J. N. Wei and J. K. W. Yang "Printing colour at the optical diffraction limit," Nat. Nanotech. **2012**, 7, 557-561.

[4] T. Xu, Y. Wu, X.Luo and L. J. Guo "Plasmonic nanoresonators for high-resolution colour filtering and spectral imaging," Nat. Commun. **2010,** 1, 59.

[5] P. Zijlstra, J. W. M. Chon and M. Gu "Five-dimensional optical recording mediated by surface plasmons in gold nanorods," Nature **2009,** 459, 410-413

[6] X. Li, T. Lan, C. Tien and M. Gu "Three-dimensional orientation-unlimited polarization encryption by a single optically configured vectorial beam," Nature **2012,** 3, 998

[7] H. Ren, X. Li, Q. Zhang and M. Gu "On-chip noninterference angular momentum multiplexing of broadband light," Science **2016,** DOI: 10.1126/science.aaf1112