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Nano-object sensing based on plasmonic superprism and carousel

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In this talk, the author is going to present two types of ultrasensitive techniques for nano-object sensing. The first one is based on heterogeneously coupled plasmonic waveguides, where giant angular dispersion (AD) as high as 5.4 degree/nm can be achieved. Full-wave vectorial finite difference time domain (FDTD) method was applied which successfully mapped out the modal evolution. It is found that the record high superprism effect originated from the modal competition at the output of the waveguide, where two oppositely swirled optical vortices form. Changing the wavelength of the incident light effectively tunes the relative strength of the vortices, resulting in a controllable beaming effect. Based on the obtained AD, the achievable sensing capability was estimated to be 740 degree/RIU. The second sensing platform was formed by a plasmonic carousel side coupled to a bus waveguide. Due to intra-cavity resonance over the coupling length, giant modal-splitting as large as $\Delta\lambda$=140 nm can be achieved. Of particular interest, the modal field distributions characterized by two individual resonances form a complementary set in spatial domain, providing two individual channels for sensing the position and polarizability (or the refractive index) of a nano-object simultaneously. Since giant modal splitting of 140 nm has been achieved, ultrasensitive nano-object detection can be readily realized with a commercially-available, handheld spectrometer with a moderate resolution.

Biography

Chao-Yi Tai has completed his PhD in 2004 from the University of Southampton in the UK. He then joined the Department of Optics and Photonics, National Central University in Taiwan, and was now promoted as an associate professor. He has pioneered in developing the first iterative algorithm which combines the Maxwell's equations and the thermal diffusion equation to accurately predict the plasmonic enhanced nonlinear Raman and thermal effect. Besides, he designed a record high plasmonic superprism, dedicating this effect to sensing applications. He is currently working on nonlinear and ultrafast plasmonic dynamics.

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