Plasmonic-based “rainbow” Chip for Intelligent Spectrometer

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In recent years, researchers and major industrial players have shifted focus toward developing miniaturized, portable, and inexpensive spectrometer systems. However, due to the classic optical diffraction limit, conventional optical imaging systems are bulky and expensive. The trapped “rainbow” storage of light in metamaterials [1] and plasmonic graded structures [2], [3] has opened up new and attractive approaches to miniaturize the spectrometers which are desirable to enable the on-chip spectral analysis. In particular, for imaging-based spectroscopic sensing mechanisms, the key challenge is to determine the spatial-shift information accurately. The capability to detect nanometric displacement in spatial position or wavelength domain is the key to realizing ultrasensitive on-chip imaging and sensing technologies. Moreover, by extended post-data processing algorithms, the spectral response of the chip can be used to reconstruct the incident spectral information. In this talk, I will discuss a plasmonic “rainbow” trapping metasurface for on-chip spectrometers and sensors. By extracting the numerical centroid of the trapped surface plasmon waves, a miniaturized imager-based platform was demonstrated for super-resolution displacement spectroscopic sensing. Further, by analyzing a single image with deep neural network, we demonstrate a plasmonic “rainbow” chip for dual-functional spectroscopic sensing. This image-based system can precisely determine the spectroscopic and polarimetric information of the illumination spectrum.

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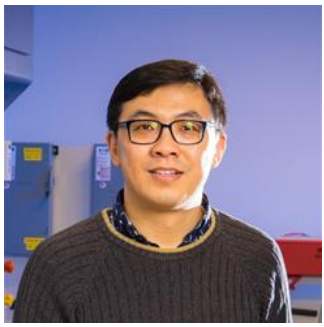
Short Bio:



Dr. Qiaoqiang Gan is a Full Professor in the Material Science Engineering, King Abdullah University of Science & Technology. He received his PhD degree from Lehigh University in 2010. He is the Fellow of Optica (formally OSA) and Fellow of SPIE. He is the recipient of Exceptional Young Investigator of University at Buffalo (2016) and SUNY Chancellor's Award for Excellence in Scholarship & Creative Activities (2019). He is the founder of Sunny Clean Water LLC (2016), a high-tech start-up company working on solar water purification technologies. His research publications include over 100 technical papers and 4 patents, with the total citation of over 8100 and H-index of 44. He serves as the editor in chief for IEEE JSTQE, associate editor for IEEE Photonics Journal, J. of Photonics for Energy (SPIE), PhotoniX (Springer), and sub-committee chair of S&I9 Photonics Integration (CLEO 2019-2020), Program Chair of S&I program CLEO 2021 and the General Chair of S&I program CLEO 2023. He organized a special symposium, Biomedical Sensors in Service of Society, for AAAS annual meeting 2018. He also served as a guest editor of special issues of Journal of Photonics for Energy (SPIE) on "Hot carrier generation" in 2016; Chinese Optics Letters (OSA) on "Metasurface" in 2018. His research activities on optical sensing and energy sustainability have been widely featured by Science, Nature, Nature Middle East, Nature Photonics, Nature Sustainability, BBC, Mirror, Salon, etc.