Metasurfaces for next-generation optics and biosensing

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Novel two-dimensional metamaterials, known as metasurfaces, have emerged as a breakthrough platform for controlling electromagnetic wave properties at the nanoscale. These metasurfaces consist of subwavelength nano-antennas, also called meta-atoms, which can be engineered at will to obtain on-demand optical functionalities. In this talk, I will show how these metasurfaces can be tailored to realize compact sensor devices capable of ultra-sensitive molecular fingerprint detection without the need for spectrometry, tunable lasers or moving mechanical parts [1,2]. Additionally, a novel high throughput and CMOS-compatible nanofabrication process of metasurfaces operating in the technologically important mid-infrared spectral range will be demonstrated. The versatility of the method is illustrated by realizing spectrally selective metasurfaces, highly-efficient meta-optical elements and optofluidic sensor devices for label-free and real-time monitoring of protein-lipid interactions [3]. In the final part of the talk, I will demonstrate how the functionalities of the metasurfaces can be further extended by incorporating active phase change materials into the meta-atom design, which has an untapped potential for next-generation tunable optical components [4].

References

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