Dielectric nanophotonics for reconfigurable planar optics and biosensing

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In this talk, we present our recent advances in the development of novel nanophotonic platforms for both imaging and biosensing. We first focus on our recent efforts towards reconfigurable metasurfaces. Our approach relies on dynamically engineering the refractive index in the close vicinity of a silicon metalens by means of a resistor embedded in a thermo-optical polymer. We demonstrate precise and continuous tuneability of the focal length, and achieve focal length variations larger than the Rayleigh length for voltages as low as 10V. The system time-response is of the order of 100ms, with the potential to be reduced with further integration [1]. Beyond focus adjustment, our technology, when combined with a genetic algorithm optimization, can be applied to generate almost any wavefront, with key applications, especially to adaptive optics [2].
In the second part of the talk, we discuss the use of dielectric nanoresonators in the context of biosensing and lab-on-a-chip technology. In our approach, Si nanocylinders on quartz are integrated into a state-of-the-art PDMS microfluidic environment. We first demonstrate that periodic arrays of Si nanocylinders can be used for the specific detection of cancer markers in human serum with sensitivity levels comparable to the one obtained with gold nanoantennas [3]. We also study the respective contribution of electric and magnetic resonances to the sensing performance [4]. Finally, we explore the use of dielectric nanoresonators for chiral molecular sensing, demonstrating, for the first time, enantio-selective differentiation with improved performance over plasmonics [5].

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