Polarization-Tuned Fano Resonances in All-Dielectric Short-Wave Infrared Metasurface

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The short-wave infrared (SWIR) is an under-exploited portion of the electromagnetic spectrum in metasurface-based nanophotonics despite its strategic importance in sensing and imaging applications. This is mainly attributed to the lack of material systems to tailor light-matter interactions in this range. Herein, this limitation is addressed and an all-dielectric silicon-integrated metasurface enabling polarization-induced Fano resonance control at SWIR frequencies is demonstrated [1]. The platform consists of a two-dimensional Si/$Ge_{0.9}Sn_{0.1}$ core/shell nanowire array on a silicon wafer (Figure 1). By tuning the light polarization, it is shown that the metasurface reflectance can be efficiently engineered due to Fano resonances emerging from the electric and magnetic dipoles competition. The interference of optically induces dipoles in high-index nanowire arrays offers additional degrees of freedom to tailor the directional scattering and the flow of light while enabling sharp polarization-modulated resonances. This tunability is harnessed in nanosensors yielding an efficient detection of 10^{-2} changes in the refractive index of the surrounding medium.

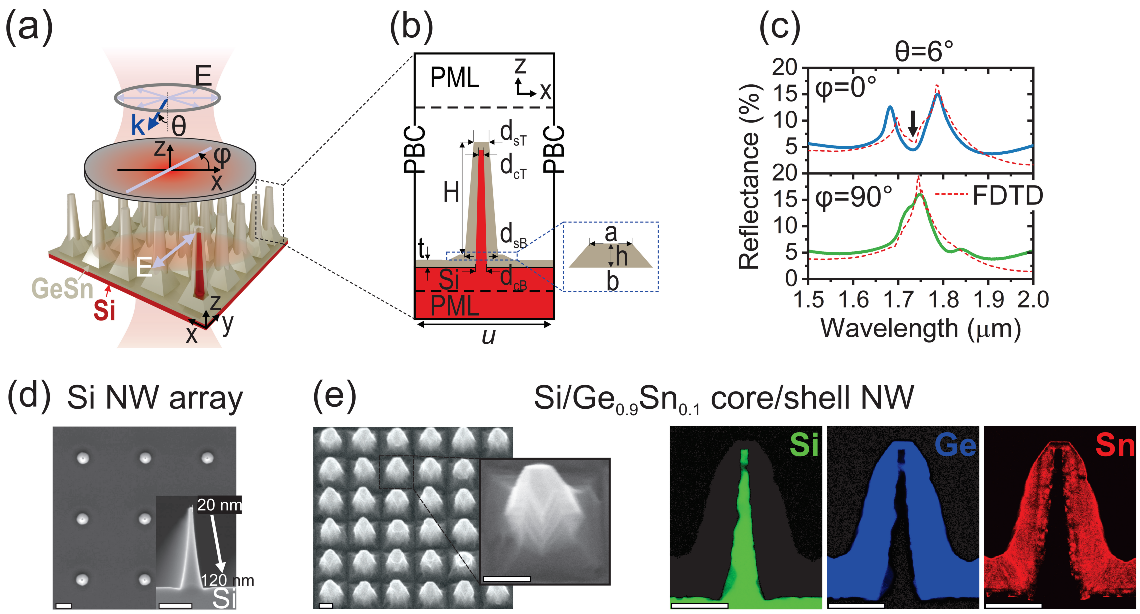

Fig. 1. Configuration of the Si/GeSn NW metasurface allowing polarization-enabled modulation of Fano resonance.

References

[1] A. Attiaoui, G. Daligou, et al., Adv. Mater. 2023, 35, 2300595 (2023).