Metaphotonics for future optical components and devices: Design, materials and manufacturing

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In this talk, I will represent AI-designed metasurfaces [1,2] and three low-cost manufacturing: 1) nanoimprinting with high-refractive-index dielectric particle embedding resin (PER)[2-9]) bandgap engineering of hydrogenated amorphous silicon (a-Si:H)[10], and 3) atomic-layer coating on imprinted resin [11,12]. a-Si [3,4], TiO_2 [2,5,6,7,8], and ZrO_2 PERs [9] are used for metasurfaces at infrared (940 nm), visible (532 nm), and ultraviolet (325 and 248 nm), respectively; measured efficiencies reach 47% (940 nm), 91% (532 nm), 72% (325 nm), and 49% (248 nm). Such PER metasurfaces are further realized for lenses, 3D/full color holography, face ID, LiDAR and eco-friendly security label [2-12]. The bandgap of a-Si:H is engineered to suppress optical losses, realizing metasurface efficiencies of 42% (450 nm), 65% (532 nm), and 75% (635 nm)[10]. We deposit an atomic layer on resin for 12-inch metasurfaces, achieving measured efficiencies of 61% (450 nm), 78% (532 nm), and 65% (635 nm)[11], and one for the ultraviolet [12]. Finally, the recent development of mass production and manufacturing of metausrfaces and nanophotonic structures, and future direction with a bigger vision will be discussed [11,12,13].

References:

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