Free Stacking of Nanostructures Based on Nanoimprint Lithography for Scalable, High Design Flexible, and Multilayer Structural Design

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Abstract

Metasurfaces are composed of subwavelength-scale nanostructures that can manipulate various properties of light, such as amplitude, phase, and polarization. Recent research demonstrates the utilization of metasurfaces as holograms by leveraging their ability to modulate the phase of light. Metaholograms, which offer advantages like compactness, multiplexing, and high spatial resolution, are employed in diverse applications including hologram displays, encryption, and gas sensors. [1] Despite these many benefits, conventional fabrication processes for metasurface production face challenges in large-scale implementation, involve high costs, and are limited by material selection, prompting the proposal of improved nanofabrication techniques. Additionally, difficulty in stacking multiple layers owing to the presence of a residual layer after imprinting.

To overcome these limitations, we developed a nanoimprint lithography (NIL) technique by incorporating nanoparticle-dispersed resin, which enhances material versatility and improves processing efficiency.[2] We also developed a tape-assisted method for the efficient and rapid removal of the residual layer.[3]

Based on this approach, in this study, we demonstrate the potential of stacking multiple layers for the simultaneous modulation of phase and amplitude in metaholograms. It is expected that this method will facilitate the simultaneous manipulation of two or more light properties.

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