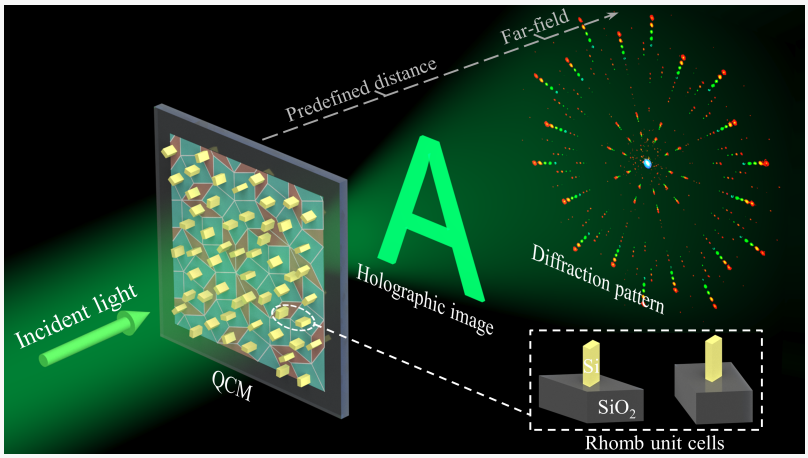
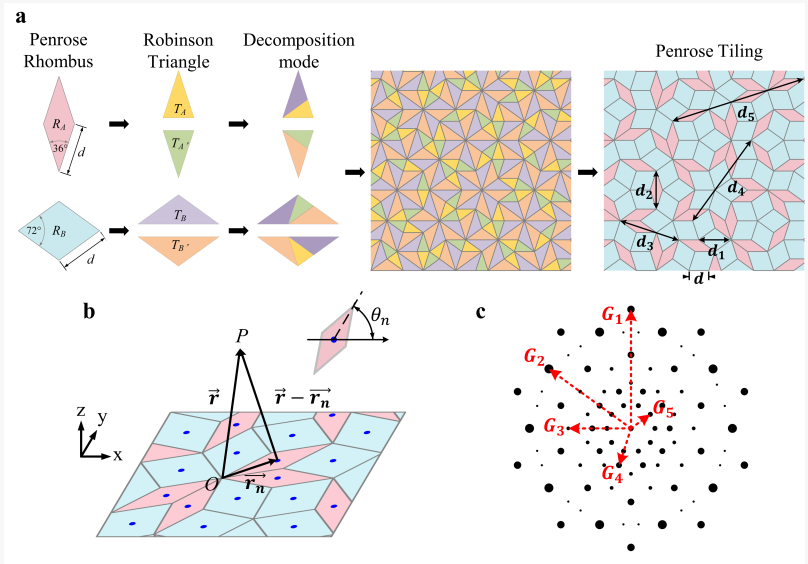
Quasicrystal metasurface projects holographic images and light patterns simultaneously

USA, June 14, 2024 /EINPresswire.com/ -- Scientists created a new metasurface that projects holograms and unique light patterns. This ultrathin material combines quasicrystals (ordered but not repeating structures) with light manipulation techniques. They achieved this dual function by arranging tiny structures and controlling light interaction. This paves the way for ultra-thin devices in holographic displays, anti-counterfeiting, 3D imaging, and even multi-substance detection tech.



Schematic illustration of quasicrystal metasurface holography.



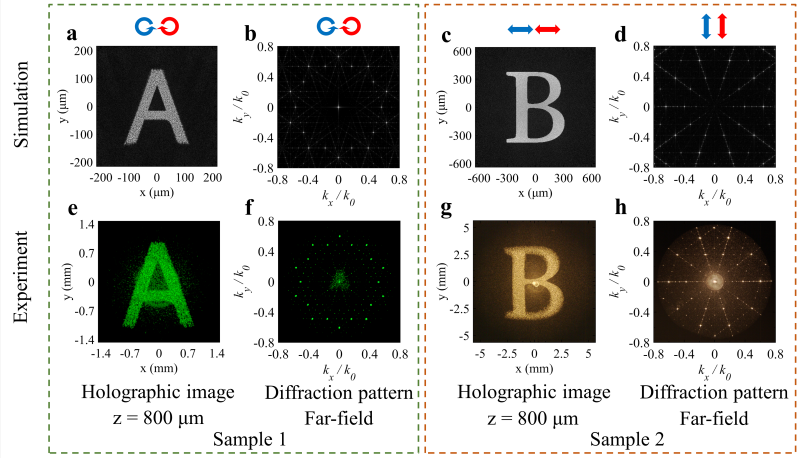
Schematic illustration of Robinson triangle decomposition method and geometrical structure factor.

Scientists have leapt forward in metasurface technology, developing a new design that simultaneously projects holographic images and creates special diffraction patterns with ten-fold rotation symmetry of quasicrystal. This ultra-thin material merges the unique properties of quasicrystals with light manipulation techniques.

Metasurfaces, already known for their ability to bend light in unusual ways, hold promise for a new generation of ultra-thin devices in areas like holographic displays, light switching, and even advanced security features.

Traditionally, metasurfaces rely on tiny structures called meta-atoms arranged in a regular grid.

This new design breaks the mold by positioning these meta-atoms in a more complex, quasicrystal pattern. Quasicrystals, while ordered, lack repetitive structures. This innovative arrangement allows the metasurface to achieve two functionalities at once.



Simulated and experimental results for Sample 1 and Sample 2.

By manipulating the phase of light, the metasurface can be programmed to reconstruct an image at a specific distance, essentially generating holographic displays. Additionally, the arrangement of metaatoms in a quasicrystal pattern creates unique diffraction patterns of light visible in the far field.

This new design offers significant advantages over conventional metasurfaces. First, its multifunctional nature allows a single metasurface to perform two tasks simultaneously, simplifying device design. Second, the quasicrystal arrangement grants more precise control over light manipulation. Quasicrystal metasurfaces have unique advantages over periodic arrangements. It can be designed by combining the global symmetry of metasurface with the local response of meta-atoms. As a result, additional functionality can be achieved.

These advancements pave the way for a new generation of ultra-thin devices with exciting possibilities. High-resolution, thin holographic displays could be created for various applications. Ultra-fast and efficient light-switching devices are also within reach. Judiciously designed diffraction patterns with high-resolution holographic images could be created for 3D imaging and optical security. For example, this technology can promise advanced security features, such as diffractive elements used in anti-counterfeiting and secure communication. Furthermore, such phenomenon may provides a new perspective for revealing multi-substances of quasicrystals that possess special arrangement together with local optical response surpassing amplitude, through simultaneously detecting the wavefront and the diffraction patterns.

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Lucy Wang
BioDesign Research
email us here