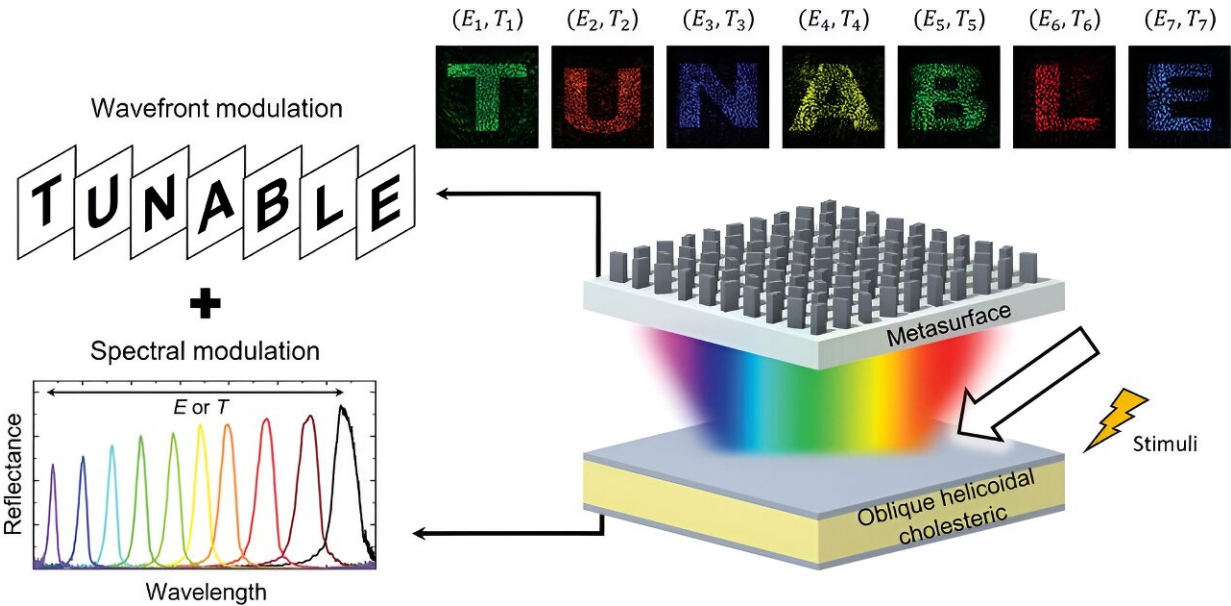


# Safeguarding the future of online security with AI and metasurfaces

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Schematic of dynamic hyperspectral holography enabled by inverse-designed metasurfaces with oblique helicoidal cholesterics. Credit: POSTECH

Researchers at Pohang University of Science and Technology (POSTECH) have advanced online security by integrating an AI-based metasurface with oblique helicoidal cholesteric liquid crystals.

Led by Professor Junsuk Rho from the Departments of Mechanical Engineering, Chemical Engineering, and Electrical Engineering, along with Dr. Sunae So (also a professor at Korea University) and Ph.D./MS

student Joohoon Kim from the Department of Mechanical Engineering and Professor Young-Ki Kim and Ph.D./MS student Jun-Hyung Im from the Department of Chemical Engineering, the team has successfully developed ten holograms in ten different colors, seamlessly switching among them.

Their research has been [published](#) in *Advanced Materials*.

The rise in [digital technology](#) has made online personal data security increasingly crucial in today's society. Encryption systems play a vital role in maintaining the stability of internet communication, serving as the cornerstone of online privacy. The realm of online security has seen a notable surge in interest regarding the fusion of metasurface technology, known for its light manipulation capabilities, with holograms.

Nonetheless, limitations have existed with respect to the amount of information that can be stored on a single metasurface.

To overcome this challenge, the research team utilized an inverse design technique driven by artificial intelligence to encode holograms with various colors and shapes across ten wavelengths ranging from 420 to 720 nanometers (nm). Additionally, they integrated an oblique helicoidal cholesterics-based wavelength modulator to accurately implement the designed holograms, even in the absence of the exact light wavelength.

The oblique helicoidal cholesterics can precisely reflect light at specific wavelengths (bandwidth external stimuli, such as electric fields and temperature, within a wide [wavelength](#) range (400 nm to 720 nm).

The research team integrated this equipment with metasurface technology to develop ten independent holograms with varying colors and shapes as switch seamlessly among them. Furthermore, they

established an optical security system requiring specific electric fields and temperature conditions for the encrypted [hologram](#) to be implemented.

Professors Rho and Kim commented, "The incorporation of various external stimuli conditions, including magnetic fields, specific light wavelengths, and electric field frequencies, enables the establishment of an advanced optical encryption platform. Moreover, this technology allows for the implementation of full-color or image holograms, positioning it a core technology in the field of next-generation displays."

**More information:** Joohoon Kim et al, Dynamic Hyperspectral Holography Enabled by Inverse-Designed Metasurfaces with Oblique Helicoidal Cholesterics, *Advanced Materials* (2024). [DOI: 10.1002/adma.202311785](#)

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