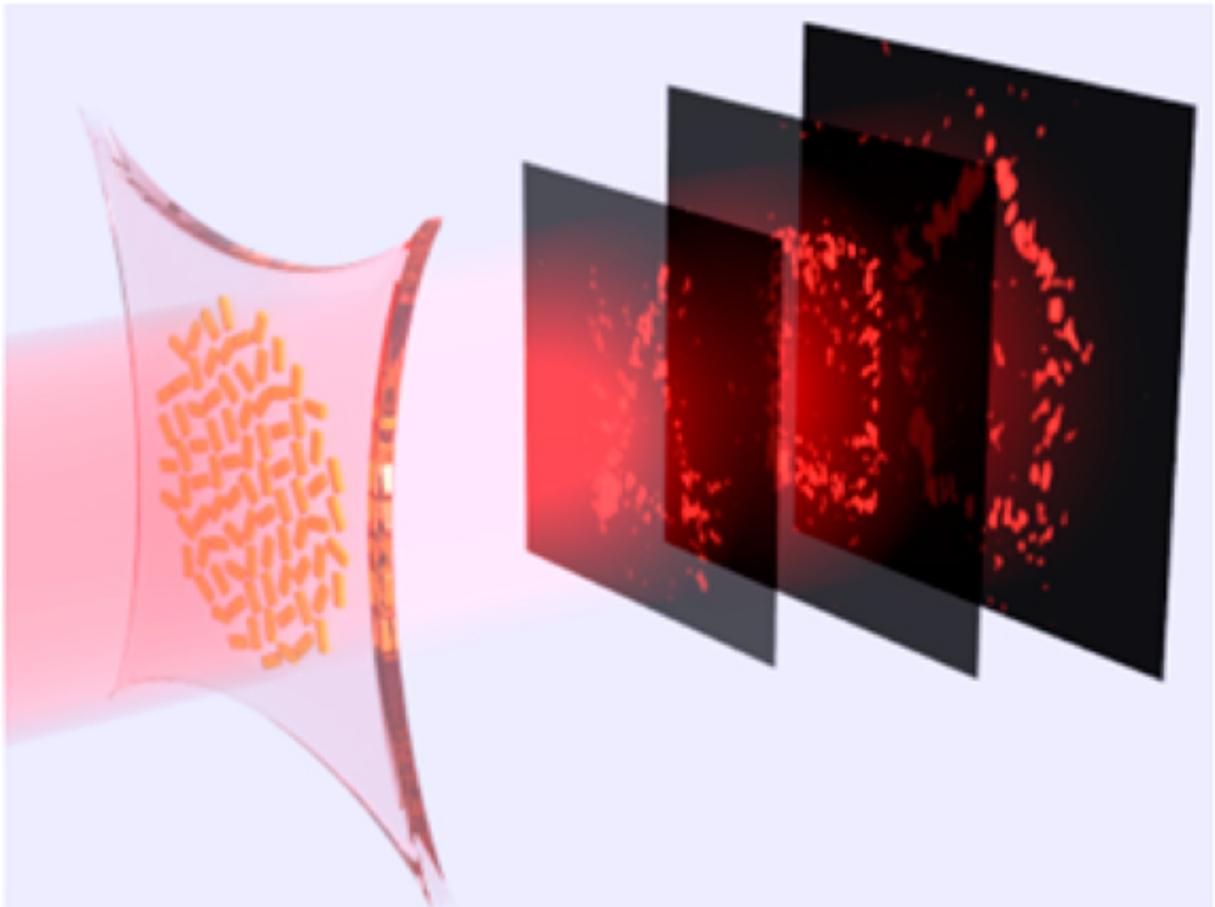


# Stretchable hologram can switch between multiple images

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Holograms made with stretchy materials could lend themselves to animation.  
Credit: American Chemical Society

The possibility of sending and receiving holographic messages has long tantalized sci-fi fans. Although we're not there yet, scientists have now created holograms that can change from one image to another as the materials used to generate them are stretched. The study detailing how they did it appears in ACS' journal *Nano Letters*.

To make their holograms, Ritesh Agarwal and colleagues turned to metasurfaces, which are flat, ultra-thin nanostructured surfaces. Previous studies have already used such [materials](#) to create 3-D and multi-color holograms, and Agarwal's team has made them recently by embedding [gold nanorods](#) in a stretchable film of polydimethylsiloxane (PDMS). Building on this work, Agarwal wanted to understand how a holographic image changes with stretching and to see if they could use this information to create a [hologram](#) that can switch between images.

Using computational models and experiments, they calculated how much a holographic image expands as the material generating it stretches, and how far the image plane moves away from its original position. Based on these findings, they created multi-layered holograms made up of two or three different images. As the surface stretches, one image appears in the place of another. So, for example, a pentagon appears at 340 micrometers away from the film in its relaxed state. Pulling on the material by a certain amount makes a square appear, and stretching it even further replaces the square image with a triangle. The new method could have applications in virtual reality, flat displays and optical communications.

**More information:** Stephanie C. Malek et al. Strain Multiplexed Metasurface Holograms on a Stretchable Substrate, *Nano Letters* (2017). [DOI: 10.1021/acs.nanolett.7b00807](https://doi.org/10.1021/acs.nanolett.7b00807)

## **Abstract**

We demonstrate reconfigurable phase-only computer-generated metasurface holograms with up to three image planes operating in the visible regime fabricated with gold nanorods on a stretchable polydimethylsiloxane substrate. Stretching the substrate enlarges the hologram image and changes the location of the image plane. Upon stretching, these devices can switch the displayed holographic image between multiple distinct images. This work opens up the possibilities for stretchable metasurface holograms as flat devices for dynamically reconfigurable optical communication and display. It also confirms that metasurfaces on stretchable substrates can serve as platform for a variety of reconfigurable optical devices.

Provided by American Chemical Society

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