Printable, colorful camouflage with polymers

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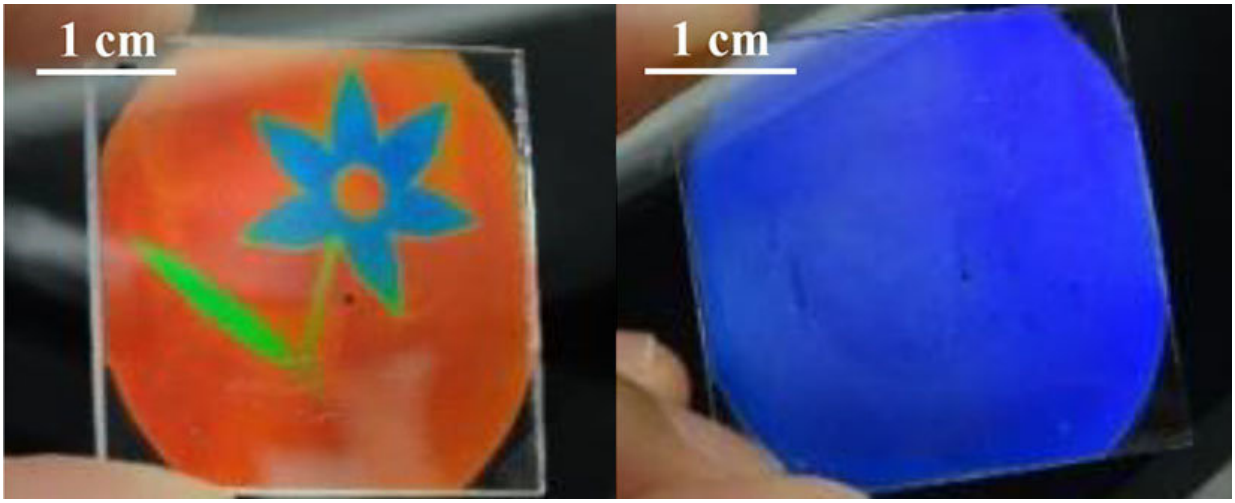

Newly developed polymer can better mimic nature's color-changing abilities. Credit: American Chemical Society

In nature, colors can serve as a form of communication, but they can also hide animals and plants, camouflaging them from sight. Researchers now report in *ACS Applied Materials & Interfaces* that they have developed polymers that can better mimic nature's color-changing abilities than existing polymers. They say the materials could enable smart decorations, camouflage textiles and improved anti-counterfeiting measures.

Most of the colors that people are familiar with, such as hues on a piece of paper, are made with pigments. But another type, called structural

color, exists, in which the color is produced by periodically arranged microscopic structures that interfere with visible light. For example, peacock tail feathers are actually brown, but microscopic structures present in the feathers make them look blue and green to the naked eye. Scientists have used cholesteric liquid-crystalline (CLC) polymers to mimic the structural coloration found in nature because they can easily be made into responsive materials. But so far, researchers have only produced them in a limited range of colors. So Albertus P. H. J. Schenning and Monali Moirangthem wanted to make CLC polymers with the full visible spectrum of colors.

The team used inkjet printing technology and a calcium nitrate solution to print an image on a CLC polymer they developed. Printing successive layers changed the degree of swelling of the CLC polymer, changing the color. One layer resulted in an orange color, a second layer changed it to green, and a third layer made it blue. As an example, the researchers used the method to draw a blue flower with green leaves on a reddish-orange background. After the ink dried, the image was no longer visible—the entire surface appeared blue. However, sprinkling water or breathing on it caused the full color image to re-appear.

More information: Monali Moirangthem et al. Full Color Camouflage in a Printable Photonic Blue-Colored Polymer, *ACS Applied Materials & Interfaces* (2018). DOI: 10.1021/acsami.7b17892

Abstract
A blue reflective photonic polymer coating which can be patterned in full color, from blue to red, by printing with an aqueous calcium nitrate solution has been fabricated. Color change in the cholesteric liquid-crystalline polymer network over the entire visible spectrum is obtained by the use of nonreactive mesogen. The pattern in the coating is hidden in the blue color dry state and appears upon exposure to water or by exhaling breath onto it due to different degrees of swelling of the

polymer network. The degree of swelling depends on the printed amount of calcium which acts as a cross-linker. The printed full color pattern can also be hidden simply by using a circular polarizer. The responsive full color camouflage polymers are interesting for various applications ranging from responsive house and automobile decors to anticounterfeit labels and data encryption.

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