

Polymer coatings mimics color changing of chameleons

Public Summary:

When we look at our surrounding, we find that it is full of colors. The colors that we see are mostly due to absorption of light by certain pigments, for example – chlorophyll in green leaves. The colors can also arise when light is reflected by periodically arranged microscopic structures. Such type of colors can be seen in chameleons, the feathers of male peacock and even in opal stones. The color changing ability of a chameleon to camouflage itself in the surrounding is well-known. This happens when periodicity changes in the microscopic structures. By using this principle, we have designed different types of polymer coatings that can change color when the environment changes.

To make these polymer coatings, we have use liquid crystalline materials. Liquid crystals are a class of materials that are present in Liquid Crystal Displays (LCDs). When they are arranged in the form of a helix, they are known as cholesteric liquid crystals. They reflect light and show colors.

By using such cholesteric liquid crystals, we have made a polymer coating that can act like a piece of paper. We can write anything permanently on this coating by using a hot pen. We have also designed a coating where we can write anything in any color of the visible spectrum by using a single ink. The information written can be easily erased by using an organic solvent. This can be very interesting for purposes like notice boards and signage which need to be changed frequently and can serve as an alternative to cellulose-based paper which needs recycling.

We were also able to make polymer coatings which can hide written information. The information reveals itself on sprinkling water or simply by exhaling breath onto it. They are fascinating for applications such as anti-counterfeit labels and decors for house or automobiles.

Besides fabricating photonic paper with different properties, we have also developed a polymer coating that can detect calcium ions in serum. The coating changes color in presence of calcium ions and by looking at the color change, we can get information about the amount of ions present. So, in simple terms, this polymer coating acts as a diagnosis strip and can tell if a person has deficiency or excess of calcium at the comfort of home.

Moreover, we have also fabricated a polymer film that can change color irreversibly when temperature increases above 0 °C. The color of the film can tell at what temperature and for how long it was kept at that temperature. This can be very useful as an indicator for shelf lives of perishable food and pharmaceutical products. For instance, by looking at the color, we will be able

to say if there was a break in cold chain during transportation and if the food or medicine are still consumable.

With our work, we have shown that we can take inspiration from nature to make polymer materials which can respond by changing color to changing environment and such technology can help to address many challenges that we face in today's world.