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Textile articles normally do not change colors. Any change in color such as fading or yellowing is considered bad. However, new types of dyes have been discovered to change color depending on the environment. Photochromic dye is one of these new types.

Q: What are photochromic dyes?

A: These dyes change color dramatically in sunlight. The color change occurs when the dyes absorb ultraviolet radiation and change into an excited state that molecular shape changes take place. This structure change leads to shift in energy bandgap, giving the molecules different color. After the radiation is removed, the dyes quickly change back to their normal state and their original color. Many photochromic dyes are colorless in the absence of ultraviolet light but when they become excited they change into another color such as yellow, blue, red and burgundy. The dye molecules need sufficient "elbow room" to "wriggle" between their two shapes. If they do not have enough room to move, no color change takes place.

Q: How can these dyes be used in textile products?

A: In theory, the dyes could be applied to textile products by conventional printing, spraying, dyeing and extrusion processes. For example, it should be possible to produce a wide range of products that change color depending on whether they are used during the day or at night, or in the sunlight or in shadow.

Q: Why are these dyes not yet widely used in textiles?

A: There are a few problems. At present, most commercially available photochromic dyes are not soluble in water and therefore they are not suitable for dyeing wool or cotton. The dyes dissolve in many solvents and are compatible with synthetic textile polymers. However, in solid materials good photochromic behaviour may not be observed because not enough "elbow room" is available at the molecular level for shape-changing to occur. The dyes are also not very stable to heat so they are damaged in processes that need to be carried out at high temperatures.

Special pigments containing encapsulated photochromic dyes are already being used to produce changeable printed patterns.

Q: Can wool be made photochromic?

A: Yes it can, but a number of problems must be solved. A new solution was found to obtain quick, dramatic and durable color change effects.

In the new method, photochromic dye is first dispersed into a special polymer at room temperature, then the polymer is coated on the outside of wool fibers by pad/cure or printing methods, and then cured. The special type of polymer contains many tiny pores (nano-sized). The water-insoluble photochromic dyes are trapped inside the pores, but the dye molecules are still able to move sufficiently to change shape. The special polymers come from the family known as silica.

To ensure marketability of any clothes produced with this technique, the polymer should not interfere with the feel of the wool and must be durable and colorfast. A search was carried out to find particular polymers that adhere strongly to wool fibers so that the colored layer can survive wear and washing. The polymer has to remain flexible so it will not affect the soft handle of wool fibers.
polymers also need to be chemically stable and transparent to UV radiation.

**Q: What are the major benefits end users may enjoy?**

**A:** This could be a new fashion trend opening up novel marketing opportunities. Garments could have changing patterns, motifs or text which become visible in sunlight or under black light illumination in clubs and discos at night.

An unexpected bonus with the polymer coating is its UV protection quality. Polymer containing the dye absorbs harmful UV rays in sunlight. Initial tests have shown these rays are almost totally blocked.

*The information was provided by Tong Cheng, Tong Lin and Rex Brady, researchers of Deakins Centre for Material and Fibre Innovation at Deakin University, Australia.*

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