Periodic graphics

A collaboration between C&EN and Andy Brunning, author of the popular graphics blog Compound Interest

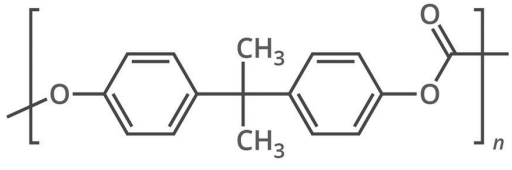
More online

To see more of Brunning's work, go to **compoundchem.com.** To see all of C&EN's Periodic Graphics, visit **cenm.ag/periodicgraphics.**

THE CHEMISTRY OF SUNGLASSES

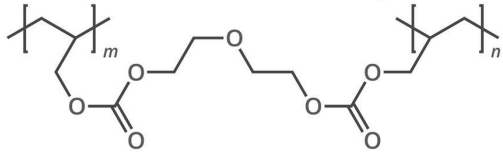
Summer's just around the corner, so people will soon dig out their favorite sunglasses. This month, we look at what sunglasses are made of, and how chemistry helps them protect your eyes from the sun's ultraviolet radiation.

LENS MATERIALS & UV PROTECTION



POLYCARBONATE

PADC



Sunglass manufacturers usually make lenses out of either glass or plastics such as polycarbonates or polyallyl diglycol carbonate (PADC). PADC is sometimes called CR-39, though this technically refers to the monomer.

Al **Ag**

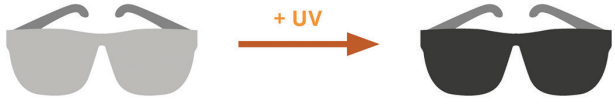
ALUMINIUM & SILVER
Can be used to give a mirrored effect

SiO **TiO_x** **Fe_2O_3** **MnO_2**

SILICON & METAL OXIDES
Various metal oxides are used to lower UV radiation transmission.

Aluminum or silver coatings give lenses a mirrored look. Metal oxide coatings reduce the amount of UV radiation transmitted through the sunglasses, protecting the eyes. The oxides can also provide a colored tint to the lenses. Organic dyes can tint plastic lenses. The exact chemicals used are kept under wraps.

PHOTOCHROMIC LENSES

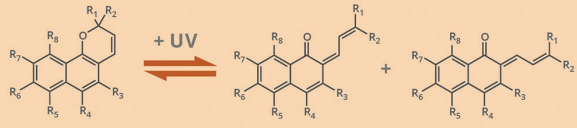


INORGANIC

SILVER CHLORIDE **SILVER ATOMS** **CHLORINE ATOMS**

The silver atoms form clusters which absorb UV and visible light. Cu^+ ions in the glass reduce the Cl atoms, stopping them from escaping.

ORGANIC



NAPTHOPYRAN **COLORED NAPTHOPYRAN ISOMERS**

Glass photochromic lenses can use copper-doped silver halide salts that produce elemental silver in UV light, causing darkening. Plastic lenses rely on organic compounds that isomerize reversibly in UV light to produce dark tints.