

# THE EVOLUTION OF THE MODERN SPECTACLE FRAME

Find out how you and your patients can benefit from today's advances in frame design and materials.

by **SANDRA CORNS PICKEL** *Wilmington, Ind.*

We've come a long way from the time when frames were made of bone, tortoise shell, animal horns, wood and a variety of metals. In this article, we'll review what you need to know about the wide variety of material choices today's dispensers have at their disposal.

## Cellulose acetate

The most commonly used plastic frame material in today's frame market continues to be cellulose acetate. Commonly referred to as zyl, cellulose acetate is manufactured by extracting cotton and wood pulp fibers, and adding plasticizers and stabilizers.

Its popularity as a choice of frame materials is due to the affordability of the material, and the ease with which the zyl can be molded, stretched, shrunk and manipulated. It also affords the dispenser a wide variety of colors in both translucent and opaque finishes.

One of its finest features is its ability to stretch slightly to accommodate a lens when heated, and the subsequent shrinkage as the material cools. This characteristic makes it ideally suited to fitting edged lenses of any lens material snugly in the frame. This stretchability lets you insert an oversized lens, and the shrink-ability lets you securely insert a slightly undersized lens. To shrink the zyl, heat and then

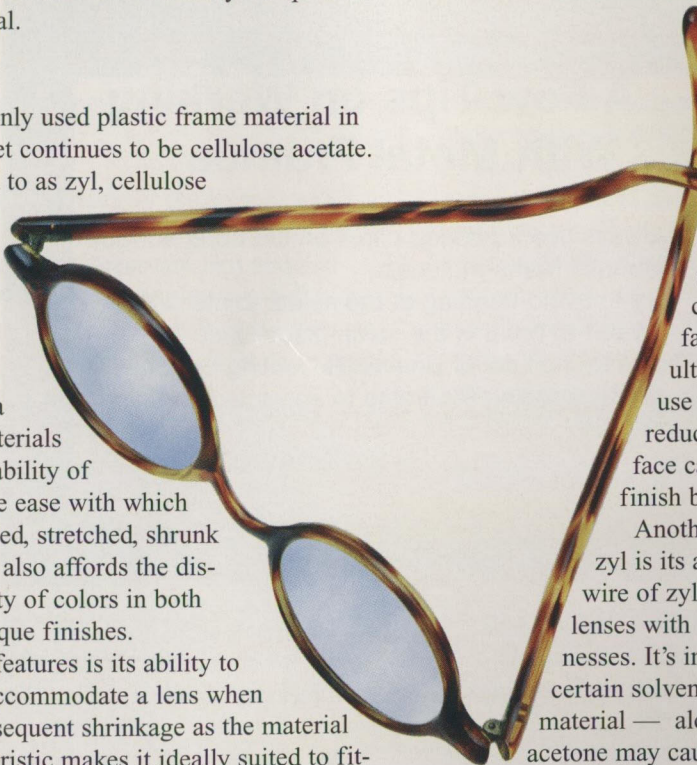
quickly cool the frame under cold water.

There are some potential disadvantages to cellulose acetate, including a tendency to bubble or melt when exposed to too much heat. Zyl may also tend to discolor and become brittle with age.

The discoloration is usually a result of the leaching out of plasticizers and stabilizers that are added to the plastic during the manufacturing process.

This chemical leaching tends to leave a dull, whitish appearance to the frame surface. In addition to the discoloration, the color will tend to fade with age due to exposure to ultraviolet light. Fortunately, the use of ultraviolet inhibitors may reduce the fading effects, and the surface can usually be restored to a shiny finish by buffing and polishing.

Another important characteristic of zyl is its ability to mold or roll the eye-wire of zyl frames. This lets you insert lenses with different bevel types or thicknesses. It's important to note that exposure to certain solvents can fade or damage the zyl material — alcohol may fade the material and acetone may cause a softening or melting effect — and that dark-colored zyl frames tend to absorb heat at a quicker rate. This would indicate a need to control



*Ms. Pickel is associate director of the optician/technician program at the Indiana University School of Optometry. E-mail her at [pickels@indiana.edu](mailto:pickels@indiana.edu).*

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the amount of time that the frame is left in your salt pan, or hot-air heater. The darker the color, the less heating time needed.

## Cellulose propionate

Another popular frame material used today is cellulose propionate, often simply called propionate. Created from the heating and compression of granules, it has many of the characteristics of acetate. Unfortunately, it's much more sensitive to heat than zyl, and should probably not be exposed to temperatures above 105 degrees Fahrenheit (40 degrees Centigrade). To avoid damaging the material, use a hot-air heater rather than a salt pan.

Propionate is slightly lighter in weight than zyl, is hypoallergenic and, like zyl, is available in a variety of colors. The sizing of lenses for insertion into propionate frames differs from that of zyl as well. Overheating will tend to shrink the material, and it can't easily be stretched. Use the cold-snap technique to insert lenses into a propionate frame. For this to be done properly, you must accurately size the lenses and insert them without heating the frame. Like zyl, propionate can be damaged by exposure to solvents, and darker colors will absorb heat faster.

## Optyl

Made of an epoxy resin, Optyl is a frame material that provides the dispenser with a choice that may be 30% to 40% lighter than zyl. The light weight, coupled with a wide number of color choices and the hypoallergenic, scratch-resistant finish, make Optyl a desirable frame material.

The Optyl material has a "memory," a unique feature owing to the nature of the thermo-elastic material. The material expands when heated, and can be reshaped to virtually any shape. Once the material cools, it sets up and maintains the desired shape, but by re-heating the frame, it returns to its original shape.

Optyl doesn't shrink, so you should edge the lenses to a slightly larger size than you'd normally use for other frame materials. Remember that if you're over-sizing the

lens, you need to compensate on the decentration of the lens during layout. It's also important to remember not to try to adjust the frame without heat, as this will result in breakage. Heating can be done with either salt pan or hot air with temperatures of about 176 degrees F. or 80 degrees C.

## Carbon fiber graphite (CFG)

A very popular frame material in today's market, carbon fiber graphite is composed of carbon fibers combined with nylon. It's commonly used to design frame fronts, and is matched with metal temples because the material doesn't lend itself well to adjustment. CFG is about 60% lighter than zyl and is an extremely strong material. Its superior tensile strength affords the manufacturers with the luxury of making very thin frames, providing a subsequent reduction in both mass and weight. Insertion is either cold snap, or by the use of a metal frame-like eyewire screw.

CFG frames tend to have baked-on enamel finishes, and the strength and durability of a metal frame. In adjusting, they should be treated like a metal frame, with the adjustments made to the metal parts, such as endpieces.

## Copolyamide (polyamide)

The stability and strength of polyamide, a lightweight nylon-

based material, make it ideal for slim-line frame designs. It's around 30% lighter than zyl, hypoallergenic, and available in a variety of translucent and opaque colors.

It has a tendency to resist adjustment, won't stretch, and is likely to shrink when exposed to temperatures of more than 230 degrees F. Make adjustments using hot air only, and be sure to cold snap the lenses. After insertion, you can heat the frame to cause some shrinkage to assure that the lenses are tightly secured. Trade names that are commonly used to describe polyamide frames include Poly-Lite, Sofyl, Polimide and Polymide.

## A Few Tips on Working With Metal Frames

- Always use a padded pliers on the outer surface of metal frame materials
- Try to avoid bending at the solder joints
- Try not to bend in the same place twice
- Due to the Law of Uneven Reflecting Surfaces, avoid exposing the frame to solvents (the finish will dull)

— SANDRA CORNS PICKEL

## Nylon

Frames made of nylon are very light in weight, and resistant to breakage. They were used extensively in the past, but are commonly used today primarily in sports protective and safety eyewear. It is recommended that they occasionally be placed in water to prevent the material from becoming brittle, and should be heated for insertion by placing the frame in hot water.

Colors are limited to solid darks (opaque), with no translucent colors possible. When adjusting, heat with hot water, and hold in place until cooled to set. The setting process can be hastened by plunging the frame in cold water after heating and molding.

## Kevlar

Made with strong synthetic fibers mixed with nylon, kevlar is also used to produce bulletproof vests. It's consequently extremely strong and lightweight. It's pliable when heated, but tends to be somewhat difficult to adjust at times. It won't shrink or stretch, but it's recommended that you heat the frame slightly for lens insertion, and sizing correctly is essential. Colors are limited to darker shades, and this may account for the limited application of this material in today's frames.

## Polycarbonate

Developed for use by NASA for the helmets and visors of the Apollo astronauts in the late 1960's, polycarbonate is the most impact-resistant lens material known to man. In addition to its application in lenses, it's used in the design of frames as well. Polycarbonate is primarily used to design sports protective and safety

eyewear.

Generally, lenses and frames are molded as one unit, making it very difficult if not impossible to adjust. Bridges and endpieces for polycarbonate frames are typically fitted with rubber parts, and the frames will be assembled with elastic straps to hold the frame firmly on the face. Polycarbonate frames can be dyed any color, although they're generally supplied clear. It's important to avoid exposure of the surface to such solvents as acetone, which will mar or discolor the surface. Insert lenses using the cold snap technique.

## A review of metal frame materials

Generally, metal frames are composed of multiple layers, with each composed of a different metal, all covered with a plastic protective sealant. Many frames use nickel or nickel silver as a base metal, but others may be made with Monel, a metal made by combining copper, zinc, iron and manganese. This combination of metals is referred to as an alloy, and Monel is by far the most common alloy used in modern frames. Here's a review of several commonly used metal frame materials.

- **Aluminum.** An extremely lightweight material, aluminum provides an opportunity to have a thick looking frame stock without the accompanying increased weight of other materials. It is very resistant to corrosion, and polishes to a nice luster. Unfortunately, it cannot be soldered, thus requiring the use of rivets to attach parts. The color or finish will tend to fade with time, and the lack of strength makes it a difficult material to adjust. It seems that the disadvantages of the material have led to its somewhat limited application in modern frames.

## Desirable Characteristics of Metal Frames

Six characteristics of metal frames manufacturers find desirable:

1. **Malleability.** The ability of a metal to be crushed, molded or worked.
2. **Strength.** The ability of a metal to bend without breaking.
3. **Ductility.** The ability of the metal's molecules to elongate without overheating the electron bond. (which limits breakage)
4. **Weight.** An inherent characteristic of any material that is related to its density and specific gravity (the lower the specific gravity, the lighter)
5. **Plate-ability.** The ability of the metal to be overlaid over a base metal in either a mechanical or electrical process.
6. **Corrosion resistance.** The ability of the metal to resist the corrosive effects of nature (chemicals, water and air).

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- **Beryllium.** Beryllium is a hard, flexible and light-weight element that is generally mixed as an alloy with other metals. When mixed with copper, it becomes resistant to fatigue, and makes a very good, springy bridge material. It is also used in endpieces and eyewires due to its ability to adapt well to different lens curvatures. It is used to help stabilize the joints of the frame, which generally tend to be weak points of the frame. Due to a relatively poor resistance to corrosion, beryllium requires a protective overlay coat.

- **Copper.** Generally, copper isn't used as a separate frame material, but as an alloy with other metals. It is extremely malleable and stable. It is often alloyed with beryllium and used to produce frame components.

- **Monel.** Monel is an alloy, and it exhibits good tensile strength and stress resistance. It is a relatively inexpensive alloy, and its stability makes it ideal for use in endpieces because of its ability to hold an adjustment. It is also a good material for manufacturing eyewires due to its strength and ductility. Unfortunately it has only moderate corrosion resistance, necessitating a protective coating, and its rigidity makes it moderately difficult to adjust.

- **Nickel.** Generally used as a base metal with other metals in alloys, nickel is extremely malleable and strong. It is also highly resistant to corrosion, and is often used in the production of guard arms (to connect the nose pads to the frame front). It is, however, somewhat expensive compared to many other metals, and this somewhat limits its use in modern frames.

- **Phosphorous bronze.** This is an alloy of copper, phosphorous and bronze that's often used to produce temples because of its superior flexibility. It tends to hold a very nice luster when polished, but has a tendency to corrode unless coated with a protective layer.

- **Stainless steel.** An alloy of iron, manganese chromium and nickel, stainless steel has made a significant resurgence as a frame material in the 90's. It is flexible and strong, making it ideal for slim-line frames. It's also very resistant to corrosion, making it an important metal for other frame parts such as the screws and closing blocks. Unfortunately, it's somewhat difficult to adjust.

- **Titanium.** Viewed by the public as a valuable commodity, this rare earth metal is about 40% lighter than most other metals. It's very strong and durable, but somewhat difficult to repair or weld. It's also relatively expensive, but tends to be perceived by the average consumer as worth the cost.

- **Flexon.** Flexon is an alloy of titanium and nickel, and like Optyl, is thought of as a "memory" material. It's up to eight times springier than spring steel, and about 25% lighter than most other metals. It's resistant

## Plating Metal Frames

The most common application of precious metals in today's frames is in electroplating. Frames are constructed of a less expensive metal base (such as nickel), then layered with gold. Quality metal frames are manufactured with multiple layer plating. The thickness of the average plating varies from 1 to 5 microns (a micron is a billionth of a meter).

This process is done with either a galvanic coating process (using electric current), or a mechanical process in which the coating is supplied in a tubular layered form. Frames made by quality manufacturers will usually apply single or multi-layered plastic protective coats to color and protect the frame.

— SANDRA CORNS PICKEL

to corrosion, tarnishing, fatigue and kinking. The initial adjustment of Flexon tends to be more time consuming than other materials, but its flexibility tends to allow the adjustment to hold longer.

- **Gold.** Historically, gold has been used to manufacture spectacle frames for a longer period of time than most metals. It's very malleable, corrosion resistant and polishes to a beautiful luster. Due to its high cost, it's usually used as a cover metal in electroplating frames. There have recently been some new frames made of gold-filled material, which consists of approximately 1/10th 12K. Gold. This indicates that 1/20th of the total frame weight is 24K gold.

### Knowing your products

Patients generally make their frame selection decision based on perceived weight, durability, adjustability and repair-ability. If dispensers truly know and understand the characteristics of the materials that they're selling, matching the material with the customer should be easy.

Take the time to get to know your products. A good way to do this is to take advantage of the information and literature that your frame sales representative has to offer. You'll be amazed just how helpful they can be if you give them the time to help. Remember that they're really a partner in your business, and should be willing to invest some time and effort in you. ●