

Periodic Graphics

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

More
online

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

THE MATERIALS SCIENCE OF CYCLING

May is National Bike Month in the US. Bicycle manufacturers use various alloys and polymers to make bike frames, tires, and accessories. Here we take a closer look at these materials.

BIKE FRAME MATERIALS

The density of the bike frame's material affects the bike's weight. The material's tensile strength determines how hard it is to deform.

Steel alloys

Fe alloyed with elements including C, Cr, Mn, Mo, and Si

DENSITY: High **STRENGTH:** Medium

Pricier and heavier than aluminum frames, but more durable—though steel can rust.

Aluminum alloys

Al alloyed with elements including Cr, Cu, Mg, Mn, Si, and Zn

DENSITY: Low **STRENGTH:** Low

Lower strength than steel, so manufacturers use larger tubes in frames.

Titanium alloys

Ti alloyed with elements including Al, Fe, and V

DENSITY: Medium **STRENGTH:** High

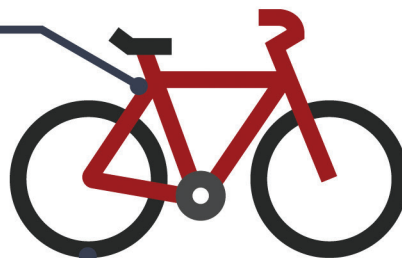
Pricier than steel or aluminum frames.
Good resistance to corrosion.

Carbon fiber

Plastic reinforced with carbon fibers

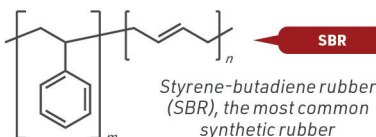
DENSITY: Very low **STRENGTH:** Very high

Properties can vary with orientation of fibers. Expensive but corrosion resistant.

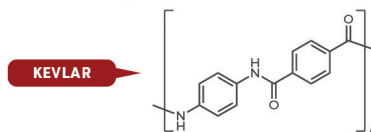


BIKE TIRE MATERIALS

Tire treads are made from rubber with reinforcing fillers such as carbon black and silica. The air-containing inner tubes are also made from rubber.

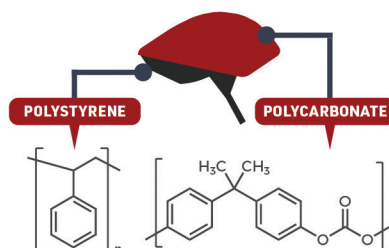


Nylon casing inside the tire holds the inner tube in place. The bead, where the tire meets the wheel rim, stops the tire falling off. Cheaper tires have beads made of steel wire, whereas more expensive tires use flexible Kevlar.



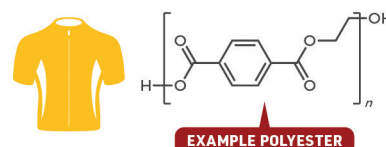
BIKE ACCESSORIES

Bike helmets



Most bike helmets have an inner impact-absorbing material made of polystyrene foam. The outer shell of the helmet is commonly made of polycarbonate plastic.

Bike jerseys



Most bike jerseys are made from polyester, which helps wick away sweat during cycling. Sometimes elastane is added to give additional strength and elasticity to the jersey.