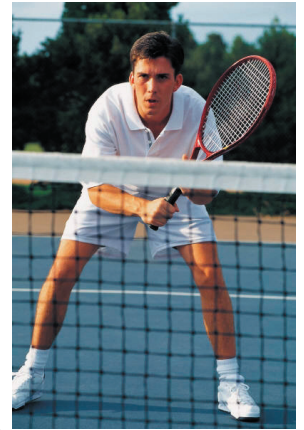


Tennis

Although the game of tennis has been around since the middle ages, today's game is quite different from the original. The first players (French monks in the 11th and 12th centuries) used only their hands as "racquets," and players hit the ball against a wall and, later, over a net. By 1500, a wooden-frame racquet strung with sheep gut and a cork-cored ball were commonly used equipment. By the 16th century, it was an indoor game, and players used long-handled racquets with small teardrop-shaped heads and played across a net.

The game as we know it today was created by Major Walter C. Wingfield, who registered a patent in London for the rules and equipment of outdoor lawn tennis. The racquets were still not quite as we know them today, but the head was usually wider and often flattened at the top. Wooden racquets survived into the 1970s with few improvements; one improvement was lamination—using thin layers of wood glued together to make the racquet stronger.

In 1967, the first metal racquet was introduced; it was made of a steel alloy. It quickly became very popular. In 1976, the first oversized racquets made with aluminum frames were introduced, and they gained popularity with tennis players. They were lightweight, had a larger "sweet spot" (the area of the racquet head where the ball is hit most effectively), and provided greatly increased power. These advantages were great for beginning players, but the combination of greater flexibility and power resulted in too much unpredictability for more advanced players. To provide more advanced players with the stiffness they required in racquets, carbon fibers were mixed with plastic resin to make synthetic graphite.



Innovation continues, and today other materials, such as ceramics, fiberglass, titanium, and Kevlar®, are constantly being tried, usually in combination with graphite. Improvements in the design of the frame also continue. In 1987, a wide-body racquet was introduced; its frame was more than twice the width of the classic wooden frame at the middle of its tapered head. Although the wide-body racquet fell out of favor, most frames sold today are wider than the traditional racquet.

With the advent of the electronic age, manufacturers are seeking new technologies to reduce the vibration created from the impact of the ball on the racquet, to make the racquets stronger and more resilient, and other innovations to help players improve their game and avoid injury. One such innovation is the use of Liquidmetal®, an alloy that prevents tennis racquets from deforming as easily, which gives the players better ball control.

Silicon carbide is a ceramic that is produced in the United States by only two companies in Illinois and Kentucky. The United States imports most of the silicon carbide it uses. China is the world's leading producer of silicon carbide.

Zirconium is an alloying metal used in Liquidmetal®. Zirconium ore is mined in the United States, in Florida and Virginia, and although much is exported, Australia and South Africa are the two leading world producers.

For more information about silicon carbide, zirconium, and other materials that go into making tennis racquets, see the USGS minerals information Web site at <http://minerals.usgs.gov/minerals>.

Sources

Cooper, Jeff, 2001, *An evolutionary history of tennis racquets* (<http://tennis.about.com/library/weekly/aa082001.htm>)
Lancaster, Mike, 2000, *Was this how tennis was introduced?* (<http://athleticscholarships.net/history-of-tennis.htm>)