What are Composites?

Read the text below to learn more about composites:

Ever since the **Wright brothers** built their Flyer back in 1903 (Image 1), the materials used in airplane design have been constantly evolving. The original Wright Flyer was comprised primarily of spruce and ash wood with muslin covering the wings, while today's airliners are made mostly of aluminum with some structure made from steel.

Image 1

In the mid 1960's, scientists and engineers began working on a new breed of aerospace materials called composites. A **composite** is an engineered material made from two or more ingredients with significantly differing properties, either physical or chemical. While no longer used today, an early example of a composite material was a mix of mud and straw that was used to make bricks. Composites have two significant advantages over some of the more traditional materials: greater strength and lighter weight.

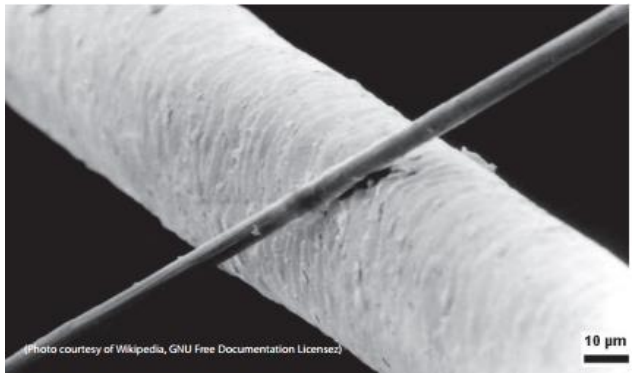

Image 2

One of the most common forms of composite in use today is **carbon fiber**. It is made by heating lengths of rayon, pitch or other types of fiber to extremely high temperatures (~2000ºC) in an oxygen-deprived oven. This heat, combined with the lack of oxygen, means that instead of combusting or burning completely, the rayon strands turn into strands of pure carbon atoms approximately 6µm (six micrometers) in diameter (Image 2). These strands are spun into a thread, then woven into sheets and mixed with hardening resins to form the various components needed.

Carbon fiber had a difficult start in the aviation industry. In 1968 Rolls Royce attempted to make the blades of a turbine engine out of carbon fiber. Unfortunately, it was determined that while they were incredibly lightweight and strong, they were unable to tolerate an impact from a bird and shattered instantly. While the US military has made a few aircraft from predominately carbon fiber, it wasn't until January 2003 that Boeing announced they intended

to build a passenger aircraft predominately out of composite materials. This aircraft, the Boeing 787 (Img. 3), took flight for the first time on the 15th of December, 2009 and is scheduled to enter passenger service in late 2011.

Image 3

It isn't just composites that have been advancing technologically. **Metals** have also seen major improvements in strength, structure and durability, which is focused on in this lesson. vNitinol is a composite of two metals, known as an alloy, of Nickel and Titanium. It was discovered in 1962 by William Buehler of the Naval Ordinance Laboratory. Nitinol (Ni [nickel] Ti [titanium] Naval Ordinance Laboratory) is one of just a few alloys that are known as Shape Memory Alloys, or SMAs.

vNitinal, more commonly known as memory wire, is the same material that is used in braces.

An **SMA**, sometimes referred to as Smart Metal, Memory Alloy or Muscle Wire, can return to its original shape after being deformed. It has many uses in the medical field as well as in aerospace, where it is used in hydraulic hose clamps, and to reduce engine noise by using the heat of the engine to control exhaust emissions. An SMA works by having the desired shape 'set' using extremely high temperatures, usually while in a vacuum. After it has cooled, the SMA can be stretched, bent, crushed or twisted. Then by applying heat, or an electrical current which through resistance causes the wire to heat, the SMA quickly returns to its preset shape. One of the most recent breakthroughs with SMAs are the creation of shape-changing heart stents. The stent is flattened before being placed into the artery and uses the body's own heat to return it to a cylindrical form. This means that the incision needed to insert the stent can be much smaller, leading to a reduced recovery time for the patient.

Adapted from Museum in a Box – Composites

http://www.aeronautics.nasa.gov/pdf/composites_k-12.pdf