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**Background**

An Optical Fiber is a flexible, transparent fiber made of extruded glass (silica) or plastic which is slightly thicker than human hair. It is similar to the light pipe that is used to transmit light between the two ends of the fiber. Optical Fiber is mainly used in Communication, power Transmission, sensors and a lot of other things.

Optical fibers are more popular than the classic metal wires due to the fact that they seem to be able to transfer information at long ranges, with lower loss of data and are not effected by electromagnetic interferences, due to the fact that they are basically acting as a guide to light waves. Light is guided through the materials by using the principle of refraction, which makes this possible.
Optical Fiber currently known as the fastest means for transferring data. But What exactly is used to make Optical Fiber. What are the materials used. And how are these manufactured?

Structure

Fiber optics has three components Fiber Core, The Cladding and The insulating Jacket. The Fiber core is the Fiber cable that carries light Signals. The cladding is a material that surrounds the core - it reflects light back into the core. Like the core, the cladding also consists of glass or plastic materials but with different densities. And the insulating jacket acts as a sheath that protects the other parts from damage or water getting through.
Materials

The fundamentals for making optical fiber need materials which are transparent and can be drawn into the fiber with the distinct core cladding structure that is uniform along the length of the fiber and will survive in the desired working environment. To make thin, uniform fiber the approach is to heat up a material until it softens into a very thick or viscous liquid and then stretch the thick fluid into the thin ligaments. Durability of the material is vital. The most common materials for years are silica based glass and certain plastics.

Silica must be doped to form either a high-index core or a low index cladding for an all-glass fiber. Flourine can reduce the index of Silica; Germanium can increase its index.

The purity of the glass used effects the degradation of the light signal being sent, regular window glasses usually the thicker it is the less clearly you will see through it. However a 1 km thick glass used in optic fibers will allow you to clearly see the other side. Therefore in optic fiber manufacturing glass purity is extremely important.

Manufacturing
The core and the cladding of an optical fiber are made of highly purified silica glass (fused-Silica Fibers). An optical fiber is manufactured from silicon dioxide. There are two methods of manufacturing. The first, **The Double Crucible Method** and another **The Vapor Deposition Process**. In the double Crucible method two crucibles, one inside the other made of platinum contain molten silica - that is being constantly fed to it as silica bars (feed tubes). The molten silica is also mixed with the required dopants, at the base fiber is pulled out.

![Diagram of optical fiber manufacturing process](http://www.photonics.com/EDU/Term.aspx?TermID=3656)

In **The Vapor Deposition Process** we create a solid cylinder of core and cladding material that is then heated and drawn into a thinner, single-mode fiber for long-distance communication. There are more three types of **Vapor Deposition Techniques**: Outer Vapor Phase Deposition, Vapor Phase Axial Deposition, and Modified Chemical Vapor Deposition (MCVD). MCVD process is the most common manufacturing technique used in current days. MCVD yields a low-loss fiber well-suited for long-distance cables.

The glass fiber optics are made from silica, which is quite good at a big range of wavelengths, and when the light being transmitted is close to infrared spectrum silica seems to have quite low absorption and scattering losses - this is mainly thanks to the extreme purity of silicon that is available. Silica is quite suitable mechanically, due to it having good strength against pulling and bending, it also is good due to the fact that it doesn't absorb water.

Plastic optical fibers tend to have a much higher attenuation, and thus its use becomes limited.

Fluoride glass is composed of fluorides and some metals. While they are quite good due to the fact that they have low attenuation at certain wavelengths. However they are vulnerable to breaking (fragile), moisture and different environmental conditions - on top of that they are difficult to manufacture. They are usually used for very specific cases in medical/industrial applications.

### Attenuation by material:

<table>
<thead>
<tr>
<th>Material</th>
<th>Attenuation Coefficients</th>
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<table>
<thead>
<tr>
<th>Material</th>
<th>Attenuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica</td>
<td>0.2dB/km</td>
</tr>
<tr>
<td>POF (Plastic optical fibers)</td>
<td>1dB/m</td>
</tr>
<tr>
<td>HMFG (Heavy metal fluoride gas)</td>
<td>at mid Infrared range can be &lt;0.2dB/km</td>
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</tbody>
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Impurities are the main cause of attenuation in standard silica glasses. Synthetic fused silica is the base for the communication fibers, it is very clear because impurities are reduced to a part per billion or less. All plastic fibers have attenuation much higher than silica fibers. They are used for image transmission or short distance communications.

References
Source: [http://www.imedea.uib.es/~salvador/coms_optiques/addicional/ibm/ch06/06-02.html](http://www.imedea.uib.es/~salvador/coms_optiques/addicional/ibm/ch06/06-02.html)