White Paper: OCT Probes

Monolithic lensing of single and multi-moded optical fibers present unique opportunities to the fields of biomedical optics, imaging, and beam shaping of fiber outputs. One of the most important and prevalent uses of monolithic fiber lensing is Optical Coherence Tomography. Currently, Fiberguide Industries offers fusing and end capping with graded index fibers of varying sizes to allow different types and forms of imaging, interference, and light manipulation to take place. Fiberguide also offers shaped tips at the end of optical fibers as an alternative to graded index lensing when weaker lensing is an option.

By fusing and cleaving a graded index fiber to a proscribed length, an optical lens is formed. Such an effect is very common in nature, and is in fact most famously seen in the eye of the fish, or the so-called "Maxwell's Fish Eye."

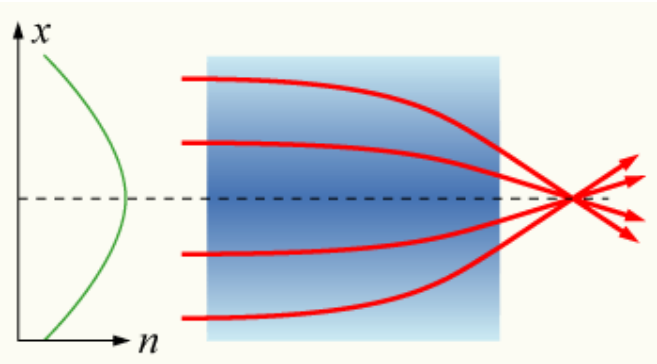

Figure 1: Graded Index Lens (Example)

When the index of refraction, which affects the speed at which light travels, is more in the center of the fiber than it is at the edges, the light at the edges can "catch up" to the light traveling through the center of the fiber, and as a result, a lensing effect is produced. The effect is identical to that seen in typical radiused and ground eye-glasses and magnifying glasses.

Such fiber devices, with the addition of one of Fiberguide Industries side fire shaped tips fused to the end can be used as a probe for Optical Coherence Tomography (OCT). See figure 2.

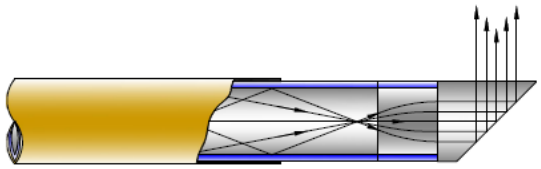

Figure 2: OCT Probe With Side Fire Tip

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OCT is a Low Coherence Imaging (LCI) technique where the interference between a light beam that hits the tissue to be measured and a reference beam only happens over very small length scales, between 1 and 10 microns. The difference in interference between long and short coherence lengths is show in Figure 3. LCI allows for spectacular resolution of transparent and opaque tissues, and presents new treatment modalities, specifically in the case where biopsy would be unacceptably damaging or impossible, such as in the imaging *in vitro* in the human retina and in atherosclerotic plaque. A typical OCT experiment is depicted in Figure 3, and an example of an OCT image of the arterial wall of the heart is found in Figure 4. Fiberguide Industries currently offers custom and standard OCT probes with different lens lengths, end cap sizes, and tip shapes.

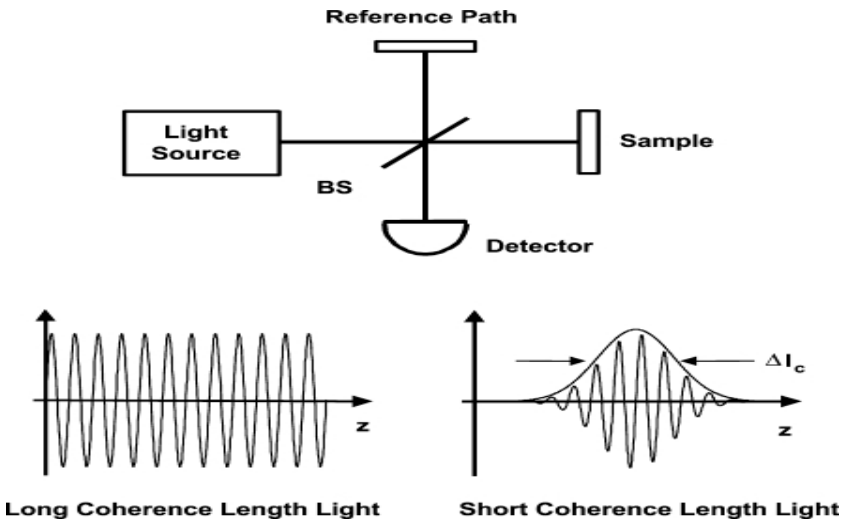

Figure 3: Coherence and Interference

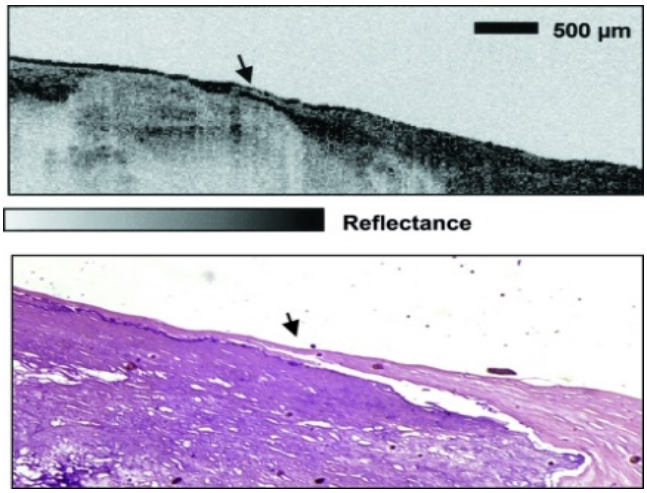

Figure 4: OCT Images Resolving Arterial Plaques; Fujimoto, James G., Neoplasia

Graded Index End caps are used for most types of fiber interference measurements and imaging experiments and devices. Fiberguide is excited to be part of the burgeoning new field of Optical Coherence Tomography, advancing science and medicine while improving patient outcomes.