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Advancements in Optical Fibres Communication

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ABSTRACT

Presently the optical fibres are mainly used in the wide area networking (WAN).The major research issues in optical communication are the development of innovative techniques to avoid physical damages, design of the efficient communication techniques and challenges faced by due to ecology & environmental issues.

***Keywords*:** Optical Fiber Cable, Graphene material, Total Internal Reflection, Optimization Techniques

1. INTRODUCTION

The first running fibre optical data transmission control was illustrated by A German physicist Manfred Borner at a Telefunken Research Labs in 1965. It had the first patent for optical fibre communication. The basic topics used for its study are Maxwell's equations, UWP (uniform plane waves), Boundary Conditions, TIR (Total Internal Reflection), Transverse Resonance Conditions, Wave guide modes, Modes of optical fibres, Properties of building materials, Network Connections via optical fibres, Study of geographical conditions, Maintenance of cables etc.

The telecom operator detects the damaged area by nullifying in the bad or problematic part causing hindrance in communication. To do this they send signal pulses through the cable from working end to the receiving end. Where there is damage present the signal bounce back, this tells us the exact position of the damage present. Then the faulty cables are lifted through

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the crane and repaired on the deck of the ship, cable is lifted using grapnel. The cable is spliced onboard, joined with a fresh cable , sealed with the device and anticorrosive jacket and is the returned back to the sea bed. Then the ship sent the information to the base stations to test the repaired cable. This process take up to 16 hours and the further addition of hours depends upon the weather conditions.

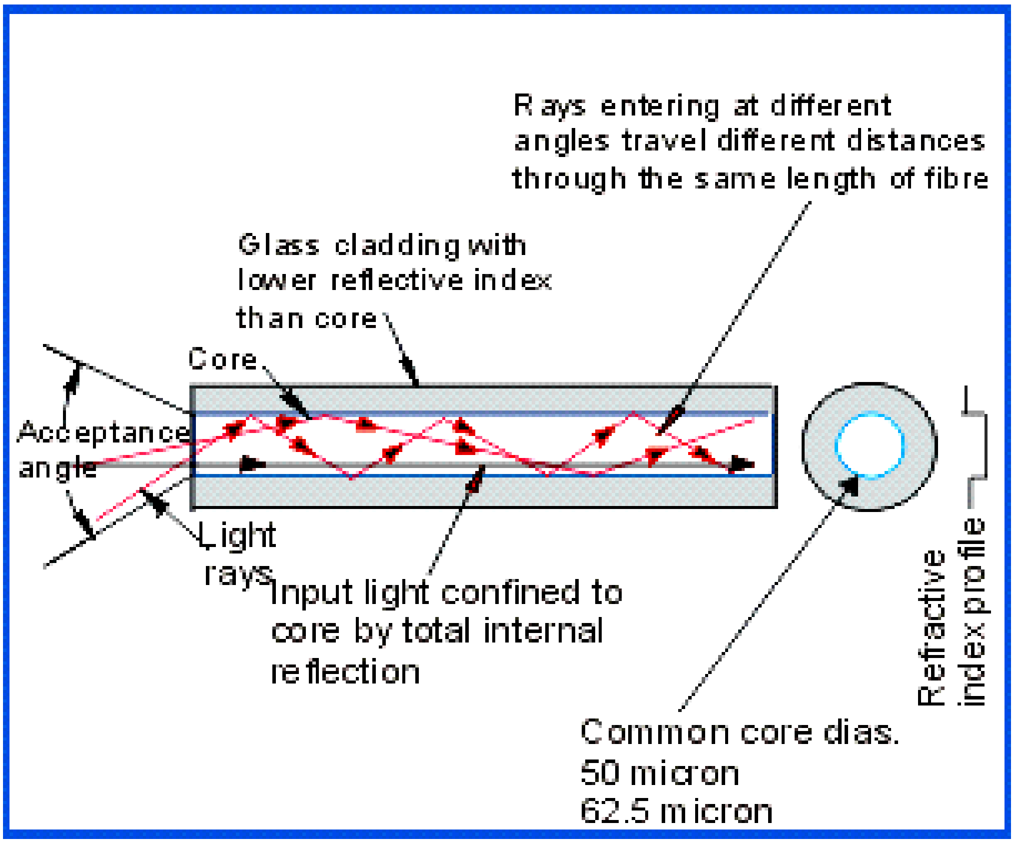

Figure 1. Internal block diagram of an optical fiber cable

2. FORMATION OF OPTICAL FIBRES USING GRAPHENE MATERIAL

At the ground level the size of the optical fibers also matters the most as the complexity of laying out the fibers in such a large amount is a challenge, threats can be anything but with graphene we can provide a basic strength to the optical fibers. Graphene consists of a single layer of carbon atoms and it is said to be one of the strongest materials. It is lighter than paper. It's electronic and industrial properties and applications are endless. The C-C bond length of graphene is about 0.14 nm. It has an internal tensile strength of 130.5 Gpa and a Young Modulus of 1 Tpa (150000000 psi). The Nobel decrement gave it the strength as of order 42 N/m and the mass of it as 0.77 mg. It will be very easy to lay the optical fibers for a long distances.

With the help of graphene we can use natural silk as the optical fibres. It is stated that Graphene is 200-300 times stronger than steel (In comparison to a single layer of Graphene.

We can take example of one of the world's thinnest but strongest fibre i.e spider silk.

The internal structure is shown in Fig. 3.

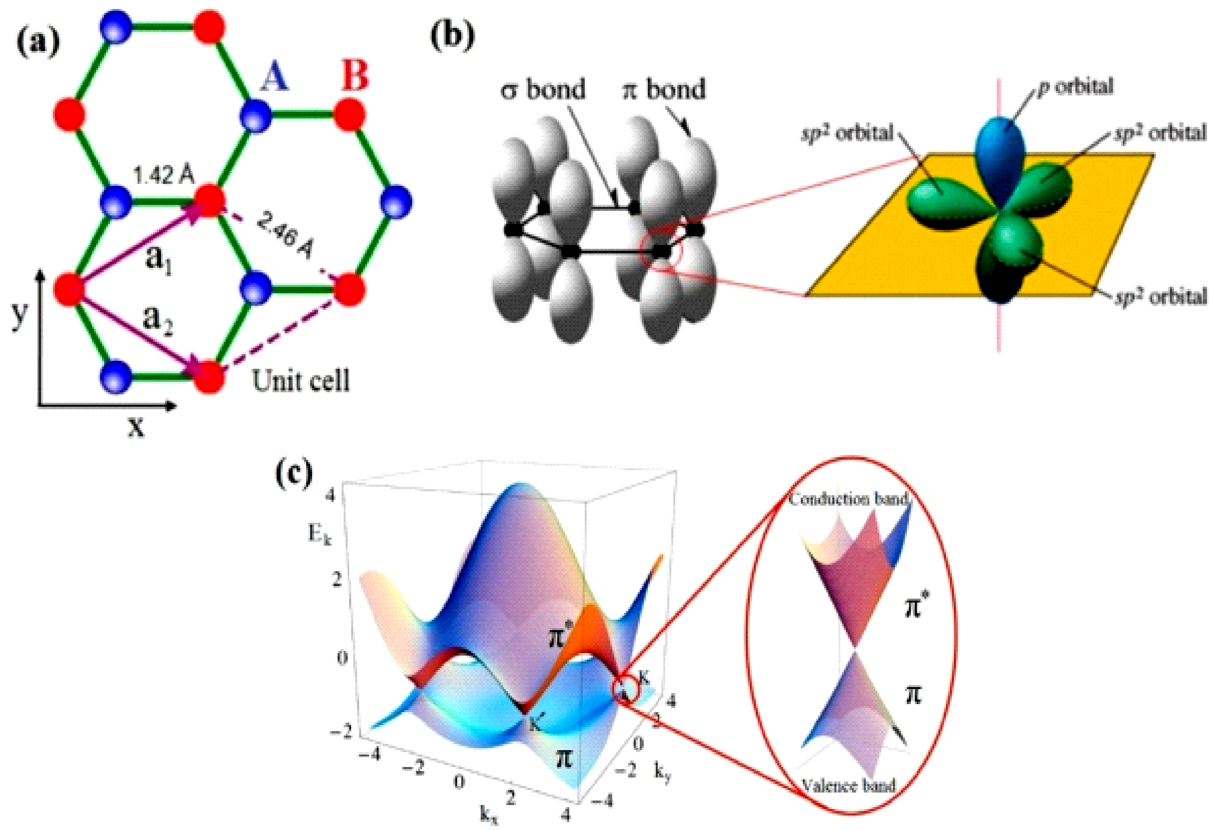

Figure 2. Structure of Graphene Material for optical fibers cables

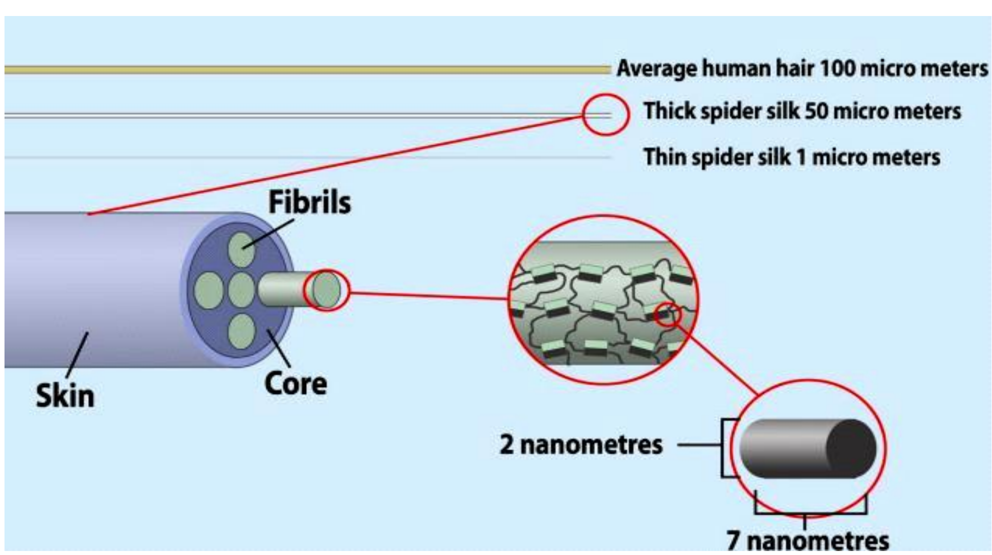

Figure 3. Spider Silk structure

With the help of graphene we can we can achieve this attribute. The no. of TIR can be reduced and we can attain the near to straight line propagation. Fiber will be so thin that thousands and even more than thousands of optical fibers can be laid in a single bigger cable.

3. MATHEMATICAL MODELLING

Let us consider the following parameters as Numerical aperture, refractive index, N.A. = Numerical aperture, n_1 = Width of cladding, n_2 = Width of core Refractive index of Graphene is near about 2.

$$N_1 \text{ Sin } (a_1) = N_2 \text{ Sin } (a_2) \quad (1)$$

where:

N_1 = refractive index of medium 1
a_1 = incident angle
N_2 = the refractive index of medium 2
a_2 = refracted angle

When a light ray passes a boundary into the medium with higher refractive index, it bends to the normal. On the other hand when a light ray passes through the rarer refractive index medium it bends away from the normal. Light itinerant from a higher refractive index medium to a lower refractive index medium it gets refracted at the 900. In other words refracted along the interface.

There is a angle through which it can be passed on which is know as critical angle. If the angle is larger than the critical angle then the light doesn't passes through the next medium and gets reflected back from the surface of the first medium and gets trapped into it and travel along the length. This phenomenon is known as TIR.

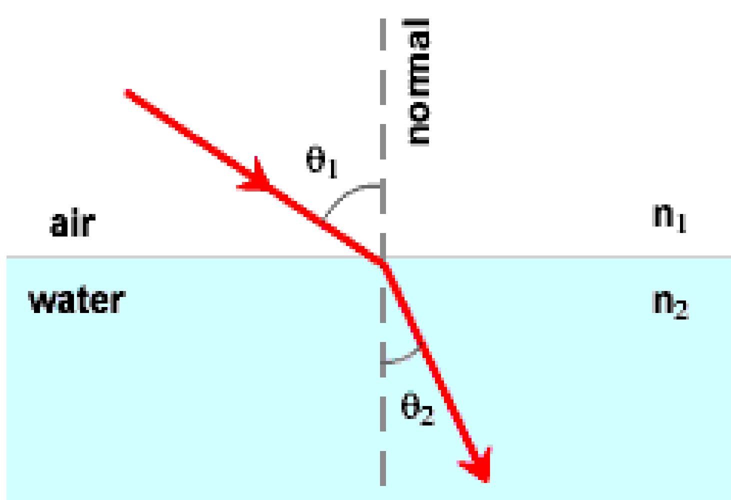

Figure 4. Total Internal Reflection (TIR)

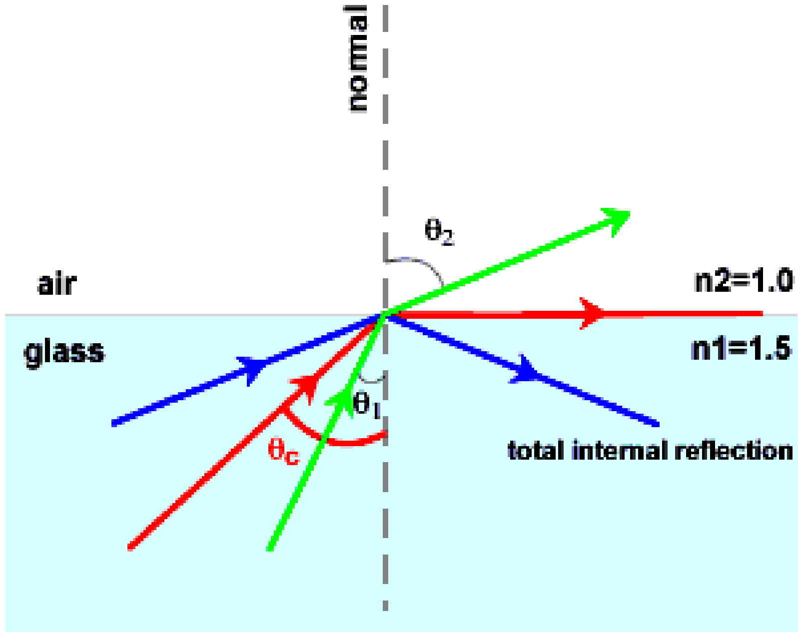

Figure 5. Multiple TIR

The critical angle (A_c) can be calculated with the help of Snell's law. Let the refracted ray angle is given as B_2, then another variable B_1 can be given as:

$$B_1 = \text{Sin}\ [(n_2/n_1)\cdot \text{Sin}\ (B_2)] \quad (2)$$

Since, $B_2 = 90^o$, therefore

$$\text{Sin}\ (B_2) = 1 \quad (3)$$

Hence,

$$Ac = B_1 = \text{Sin}\ (n_1/n_2) \quad (4)$$

4. CONCLUSION

It is concluded from the above discussion, that we can built an optical fiber so thin and strong that can get us profiting in a domain related to the communication. The use of natural silk or a similar artificial silk and jacket of that silk can be made from the Graphene material that can save the bundling of an optical fiber. This will reduce the physical traffic of optical fiber cables.

The one cable can contain thousands of silk-fiber graphene covered optical fibers. It will meet the modern designs and architecture and high bandwidth carrying capacity communication channels.

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