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Can Wood Replace the Constituent Material of Optical Fiber?

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Abstract

This concise communication gives an overview over development of optical fibers from wood. Initiating from process of synthesis, the implications of this novel development is briefed here.

Keywords: POF: Plastic Optical fiber; PMMA: Poly(methyl methacrylate)

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Since its' invention, optical fibers have played a pivotal role in waveguides. Precisely, they function as the conduit of light. As such, they offer remarkable speed of data transfer because of light passage at a high speed. If we look at the construction of simple optical fiber, it consists of core which is then surrounded by cladding. The underlying condition is that the refractive index of the core is higher than that of the cladding. As a result, the propagating light remains confined within the core as it suffers total internal reflection. The refractive index plays the pivotal role in determining the propagation of light within it. In general, optical fibers are made from silica which is termed as glass optical fibers. The refractive index of the cladding is made slightly lower than that of the core by using suitable dopant while preparing the preform. Most importantly, the index difference often is kept at a value of ~0.05. The glass optical fibers enjoy the merit of high sensitivity. However, flexibility as well as high manufacturing cost play as deterrent in their applications. Accordingly, the optical engineers turned towards plastic optical fiber. Popularly known as POF (Plastic Optical fiber) or PMMA, this category of fibers is primarily constituted by polymer. In similitude to that of glass fiber, the guiding principle remains the same. The transmittance occurs through the core only. Besides, unlike the glass optical fiber, the property of bending or stretching put POF in a more advantageous position which is further assisted by lower price tag [1-3].

Although these fibers come with their merits along their unique properties, one thing for sure that these types of fibers are not biodegradable in nature. In both cases, it will take a considerable time for eventual degradation. As a result, they become waste materials once wear and tear appear in their functioning; thereby becoming a mounting environmental hazard. In the quest to explore alternatives, researchers ventured into unconventional practices [2,3]. A team of illustrious researchers came up with a unique concept of using wood as one of the alternative constituent materials for fabrication of optical fiber. They used cellulose as an optical fiber material because the chemical processes involved during the synthesis process of cellulose allow user to tune the refractive index as per requirement. The raw materials had been the dried out and bleached softwood kraft pulp in a slurry format. With the help wet-jet spinner, they were able covert this slurry into lengths of fiber core. To coat it with a cladding of lower refractive index, they used commercially available cellulose acetate. After fabrication, they tested it for waveguide applications. They were successful in using this ecofriendly fiber in the optical wavelength range of 500 nm to 1400 nm. However, the visible range could not achievable [2,3].

Replacing the constituent material of optical fibers by biodegradable material is really a herculean task. The use of cellulose as fiber material is going to make paradigm shift in the optical industry provided all requisite of waveguides are well attributed to this constituent material. The favorable properties of cellulose such as active reactivity with specific substances as well as better water absorptions make them ideal for sensing applications [2,3]. Although, it is a little bit early to say that they will make revolution in the telecom sector; however, they have

immense potential to be implemented in sensing schemes of moisture detection as well as other relevant protocols [3].

References

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