Clemson University Research Foundation

Brillouin Optical Fiber that Resists Heat Stress (2012-082)

Sapphire-derived optical fiber contains Brillouin frequency for better performance under high-temperature conditions

Market Overview

Optical fibers enable of a wide variety of modern technologies. However, during use optical fibers generate heat, negatively impacting their performance. This form of thermal dependence is especially problematic for high-energy fiber laser and optical fiber sensor systems. Currently, the market for optical fiber sensors is projected to be $4 billion by 2017 and experience a growth rate of 20.3%. The addition of alumina to the silica fibers can mitigate the thermal effects on the fibers, however, conventional methods severely limit the addition of alumina. In order to solve this problem and take advantage of the optimal market environment, Clemson University researchers developed a novel process that uses a molten-core technique to add sapphire (Al_2O_3) to silica (SiO_2) glass. Ultimately, this is a scalable manufacturing technique that allows for unstable glasses to be directly obtained in fiber form, creating an optical fiber that has a temperature-independent acoustic spectrum.

Application

High energy fiber lasers; optical fiber sensors

Stage of Development

Validated Prototype

Advantages

- Manufacturing method drastically reduces acoustic scattering, eliminating a significant drawback of current high -powered systems
- Precursor materials are relatively low-cost, enabling scalability and competitive pricing for entry into new markets
- Process utilizes a continuous high-speed manufacturing compatible with existing commercial techniques, allowing for easy adaption and implementation

Technical Summary

Clemson University researchers developed a molten-core technique to add sapphire (Al_2O_3) to silica glass (SiO_2). The addition of alumina to silica fibers greatly enhances the fiber's immunity to selected optical non-linearities. The core material is able to melt at the temperature in which the cladding glass draws into the fiber. The high quench rate permit s previously unrealizable core compositions to be directly obtained in fiber form. This invention accomplishes the formation of an optical fiber whose acoustic (Brillouin) spectrum is temperature-independent, a characteristic that has never been previously validated.

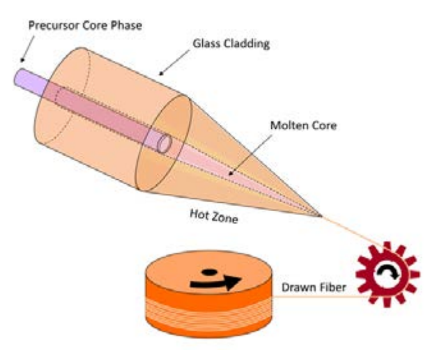

Figure 1. Pure sapphire (Al_2O_3) rod sleeved into a large thick-walled SiO_2 tube and drawn into fiber.

App Type	Country	Serial No.	Patent No.	CURF Ref. Number	Inventors
Utility	United States	14/245,448	9,139,467	2012-082	Dr. John Ballato Dr. Peter Dragic

About the Inventors

Dr. John Ballato is a Professor of Materials Science and Engineering and Director of COMSET, which is a South Carolina Research Center of Economic Excellence. He earned his Ph.D. in Ceramic and Materials Engineering from Rutgers University in New Jersey. Previously, Dr. Ballato served as the interim Vice President for Research. He has published more than 200 archival scientific papers, holds 25 U.S. and foreign patents, has given in excess of 125 invited lectures/colloquia, and has co-organized 25 national and international conferences and symposia. Dr. Ballato's primary research interests include new optical materials and structures for high-value photonic and optoelectronic applications.

For More Information

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