Molten Core Flux Formation Method and Fibers Formed Therefrom (2021-041)

Novel Improvements Upon the Molten Core Method Technique for Creating Semiconductor Optical Fibers

Market Overview

Semiconductor optical fibers marry the enablement of modern electronic devices of semiconductors with the light-guiding capability of fiber optics. Combining these attributes allows for the desirable material properties of important semiconductor phases in the form of long lengths of fiber. Semiconductor optical fibers are made using one of two approaches: the molten core method and a chemical vapor deposition method. The molten core method melts the semiconductor at a temperature where the glass cladding softens and draws to fiber. Historically, technologically important semiconductors, such as GaAs and ZnSe, cannot be made into semiconductor optical fiber using this method because of high vapor pressure exploding the preform before the fiber can be formed. Clemson University researchers have developed an improvement upon the molten core method that adds a secondary phase to the semiconductor precursor allowing for a lower vapor pressure. A plurality of phases may form upon cooling, including the desired compound. The other phase can be removed via conventional thermal or laser annealing.

Technical Summary

The molten core flux method builds upon the molten core method. The molten core method approach creates semiconductor optical fibers by melting the semiconductor at a temperature where the glass cladding softens and draws to fiber. The improved process adds a secondary phase to the semiconductor precursor that the two phases form a homogenous solution about the liquidus. The liquidus temperature is reduced relative to the melting point of either of the pure compositions. The homogenous liquid has a low enough vapor pressure to prevent the explosion of the semiconductor/glass preform prior to the drawing of the fiber. Therefore, the low vapor pressure allows the glass-clad fiber to be drawn. The molten core flux method has demonstrated promising initial results with both GaAs and ZnSe. GaAs semiconductor optical fiber was achieved as the dominant core phase with single secondary phase that is relatively low melting.

Application

This technology opens the door to practical optical fibers containing important semiconductor phases, such as GaAs and ZnSe, that generally cannot be made into fiber because of their high vapor pressures. These optoelectronically critical semiconductor phases can now be made into optical fiber using scalable and industry-accepted draw methods, followed by established laser post-processing.

Development Stage

TRL 3: Proof of Concept

Advantages

- Low vapor pressure allows for semiconductor optical fibers to be made from desirable materials, such as GaAs and ZnSe.
- Uses industry-accepted draw methods and established laser post-processing, enabling scalability.

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Provisional	United States	63/288,925	NA	2021-041	John Ballato Thomasina Zaengle Baris Kukuoz Ursula Gibson

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John Ballato is a professor of Materials Science and Engineering and the J.E. Sirrine Endowed Chair for Optical Fiber at Clemson University. He has published over five hundred technical papers and holds thirty-four U.S. and foreign patents. Among numerous other honors, he is a Fellow of the American Ceramic Society (ACerS), the American Association for the Advancement of Science (AAAS), the Institute of Electrical and Electronics Engineers (IEEE), the American Physical Society (APS), the Optical Society of America (OSA), and the International Society of Optical Engineering (SPIE), as well as an elected member of the World Academy of Ceramics.

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