Recommended Apparatus to Improve Fibers' Fusion-Splice Equipment

Applications Note

Issued: June 2011

Rashid Gafsi; Corning Incorporated

Fibers' splicing is one of the essential and critical procedures for fiber optics and photonics devices, modules and networks. The purpose of this paper is to present a recommended apparatus which allows reducing the frequency to clean the electrodes of the fusion – splicer equipment when Corning's erbium doped fibers are spliced together or to other type of all-silica fibers. Also, this recommended apparatus for the fusion-splicer equipment enables an improved consistency, reproducibility and repeatability of the optimized recipe which is developed for the fusion-splice of erbium doped fibers to other fibers as well as multiple all-silica based fiber combinations.

An optimized and successful fibers' fusion-splice process provides a low splice loss and high reliability for the joined fibers. Corning Incorporated has been manufacturing erbium doped specialty fibers for over 20 years and was the first to manufacture hermetic coated erbium doped fibers. It has been demonstrated and proved that hermetic coated erbium doped fibers provide high mechanical reliability and reduced optical attenuation related to hydrogen exposure in EDFAs. Also, hermetic coated erbium doped fibers enable compact and miniaturized devices and modules without compromising their reliability. The hermetic carbon coating layer is deposited on the erbium doped fiber during the draw and before the application of the primary coating. The hermetic coating is typically about 50 nm thick layer of disordered graphitic platelets or ribbons.

The fusion splice of fibers is typically done using an electric-arc fusion splicer machine. There are several manufacturers and various models and brands of fusion-splicer equipments. The most commonly used fusion splicers are plasma type. For plasma type fusion splicer, thermal energy is generated by the electric discharge through two electrodes which are facing each other with an air-gap. The fusion splicer's electrodes age over time due to the deposit of non-conductive type elements (organic and inorganic) which are release from fibers and to the oxidation of the electrodes. The aged electrodes induce a fluctuation of the plasma heating intensity which leads to an inconsistent fusion splice, high splice loss, manufacturing variability, splices' rework and low manufacturing yields. Corning invented an apparatus to improve consistency of fusion splices and to reduce the maintenance and cleaning cycle for the fusion splicer electrodes. This apparatus was disclosed in the international application WO 02/063650 A1, published in August 15, 2002. The apparatus is described in the schematic of Figure 1 and the concept is based on the placement of an insulator sleeve to protect the electrodes of the fusion splicer from non-conducting elements and to reduce the oxidation of the electrodes. The insulator sleeve could have an inner diameter which is slightly larger than the diameter of the conducting electrodes and an outer diameter which allows its installation in the fusion splicer equipment. The material of the insulator sleeve can be alumina, silicon carbide and zirconia. The insulator sleeve can be attached to the base of the electrode with an adhesive such as ceramic cement, ceramic putties or refractory cement. The insulator sleeve might be tapered at the no attached end face to match the size and shape of the conductive electrodes of the fusion – splicer, in order to allow clearance for the fusion splicer's fiber alignment optics. The schematic of figure 2 illustrates an example of a tapered insulator sleeves protecting the conductive electrodes.

The proposed and recommended apparatus for the electrodes of the fusion splicer equipment reduces the maintenance and cleaning cycle of the fusion-splicer equipment used with carbon coated erbium-doped fibers and several other types of all-silica based fibers. Also, it improves splices consistency, reproducibility and repeatability of the optimized recipe developed to fusion splice fibers which will lead to high manufacturing yields; low splices' reworks and reduces cost.

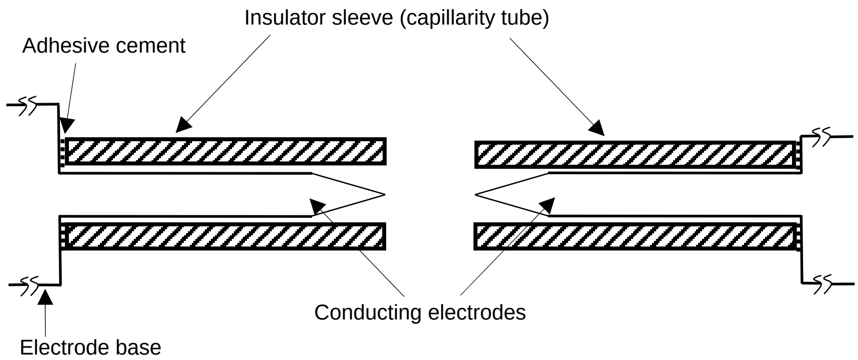

Figure 1 Schematic for the cross – section of electrodes with the apparatus

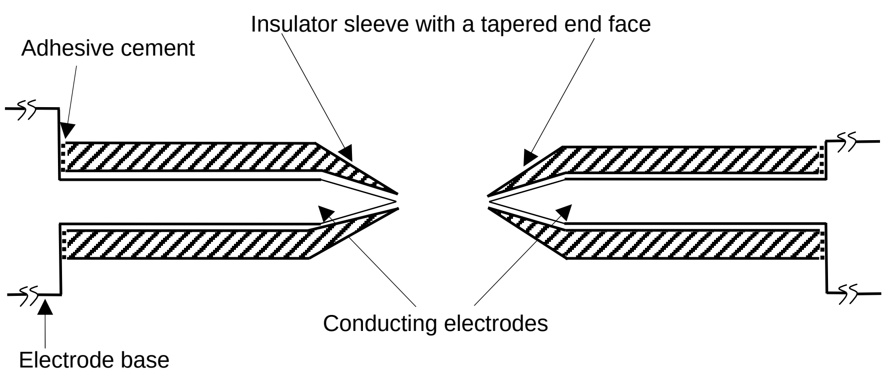

Figure 2 Schematic for the cross – section of the tapered sleeve protecting the electrodes

The author would like to thank Kevin W. Bennett, Dawn M. Sutherlin and Robert S. Rider Jr. for their review of the paper and fruitful discussions.

References:

[1] Jeffrey T. Kohli and G. Scott Glaesemann "Corning's Hermetically Coated Erbium-Doped Specialty Fibers," Corning white paper http://www.corning.com/WorkArea/showcontent.aspx?id=14657

[2] Lewis K. Klingensmith, Richard Rebis and Dewey D. Storm, "Plasma fusion splicer electrode", International patent # WO 02/063650 A1 (Publication of 15 August 2002)