Aperture Description of Coupling of a Microring Laser to a Fiber

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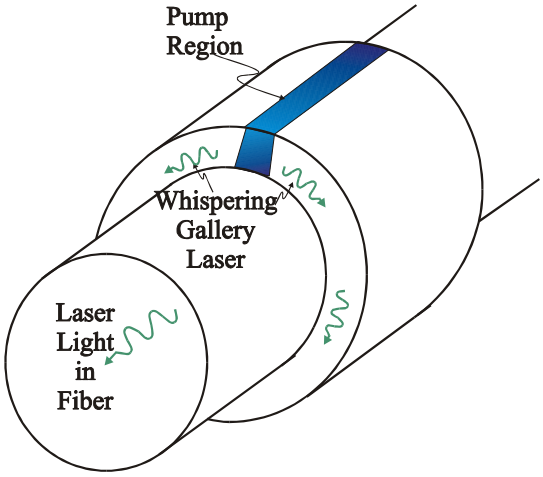
Recently, microring lasers have been formed from optically active polymers formed into a circular band, using an optical fiber as mandrel (see figure at right) [Frolov, *et. al.*, *Appl. Phys. Lett.,* 72(22), pp. 2811-2813]. Gregory has observed that light delivered into the fiber can pump the microring laser [R. V. Gregory, Private Communication]. Indeed, the Frolov paper suggests the possibility of coupling into the fiber by way of evanescent tunneling. Gregory's observation is simply that of the reciprocal path. We note that a gold barrier is present between the band and the fiber.



This paper presents a quantitative description of the coupling of electromagnetic energy from the laser into the fiber by way of evanescent tunneling. This description can be deduced from consideration of the field over two aperture planes defined by the end faces of the circular band and penetrating into the fiber. The field of these whispering gallery waves can be described in the band and specifically on the aperture planes defined just at the edges, which are adjacent to the monomode fiber. Thus, equivalent sources on the aperture faces are capable of exciting the fiber mode through the mechanism of evanescent tunneling.

The coupling across the apertures is necessarily weak, else energy would be taken from the laser so quickly that lasing would be quenched. Consequently, it is adequate to view the aperture sources as unperturbed by the loading of the fiber. With in constrains of the weak coupling requirement, one can employ the aperture description to deduce means of optimizing the coupling of light leaking from the edges of the laser into the fiber.

A proposed application of microring laser is as pump sources on erbium-doped fiber amplifiers. A distribution of the rings along the fibers would accommodate pumping in a geometrically simple fashion.

We discuss the aperture model for this structure and our current understanding of means for optimization of the laser/fiber coupling.

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