

Erbium 3- μ m Fiber Lasers

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Invited Paper

Abstract—With its recent breakthrough in terms of output power, the erbium 3- μ m fiber laser has become an object of intense scientific research and an increasingly attractive tool for medical applications. This paper reviews the research on the erbium 3- μ m fiber laser since its first demonstration. Its development is seen in relationship to the early success of the corresponding crystal laser system, to the foundations that were laid by the investigation of its spectroscopy and population mechanisms, and the recent technological developments in related fields.

Index Terms—Cascade laser, energy recycling, energy-transfer upconversion, erbium, excited-state absorption, fluoride fiber laser, laser efficiency, laser in surgery, mid-infrared laser, upconversion laser.

rare-earth dopant concentrations comparable to those used in erbium 3- μ m crystal lasers still represents a major problem for the fiber suppliers. On the other hand, the early success of the erbium 3- μ m crystal laser has given rise to a significant amount of spectroscopic investigations mainly in Russia and later on also in Western Europe and the United States. This has led to a deep understanding of the population mechanisms of this laser system and to the development of a large number of suitable host materials. Compared to these tremendous research efforts, the spectroscopic accounts of the erbium 3- μ m fiber laser remained few, and it is characteristic that the first breakthrough [6] of the fiber laser in 1995 was based entirely on a better understanding