Convergent-Photonics Introduction

Since the first successful operation of a laser in 1960, many different types of laser have been invented – large gas lasers for cutting metal, tiny diode lasers in laser pointers, lasers that use crystal rods, flowing gases and even liquid dyes as the active laser medium. But many of these older lasers are now being replaced by fiber lasers, made of hair thin strands of glass – optical fiber.

In the simplest fiber, the central glass core is surrounded by a cladding layer. Light is confined to the core because of the difference of index of refraction, or speed of light, between core and cladding. So how can such fragile strands be made into a laser?

It starts by adding a rare earth element such as erbium, ytterbium, or neodymium to the core glass, creating "active fiber". The rare earth atoms are excited by light from other lasers, usually diode lasers. Light is coupled into a second cladding layer of the active fiber. Laser light is reflected back and forth in the active fiber as it is in the resonator of a larger laser.

Because the light is generated inside a fiber it can be easily coupled to robots, making material processing of complex shapes possible. Fiber lasers are compact, rugged and efficient and have excellent beam quality. With powers ranging from watts to tens of kilowatts, fiber lasers are replacing older, less efficient lasers in applications such as material processing, telecommunications, spectroscopy and medicine