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Novel Er:Yb:phosphate glass fiber laser pumped by a 946 nm Nd:YAG laser

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We have demonstrated, to our knowledge for the first time, an Er:Yb phosphate glass fiber-laser, pumped by a 946 nm Nd:YAG laser. 110 mW at 1.53 m has been achieved using 22 cm fiber.

Recently, Kigre introduced a new family of rare-earth doped glass fibers [1], based on phosphate laser glass. Due to their phonon energy, erbium-doped phosphate glasses exhibit lower up-conversion losses than silica glass. This, and the high solubility for rare-earth ions, makes phosphate glasses promising candidates for high-gain erbium devices. High doping concentrations enable short devices, and fiber lasers or amplifiers with only a few centimeters of active fiber can be realized. This is to be compared to standard, telecom EDFAs that normally contain tens of meters of erbium-doped silica fibers.

The fiber introduced by Kigre, designated QX, have a high potential for high power application and in the field of telecommunication. The single-mode fiber used in this experiment has doping concentrations comparable to standard phosphate glass waveguides. The Er:Yb co-doped fiber core has a diameter of about 7 m and an almost perfect mode match to standard communication transmission fibers at 1.54 m.

The experimental setup is schematically described in Figure 1. A diode-pumped Nd:YAG laser operating at 946 nm was used for pumping the fiber. The pump laser produced a stable cw output of up to 4 W at 946 nm with good beam quality ($M^2 < 3$). The absorption cross-section of ytterbium at 946 nm is about 5 times smaller, but much less wavelength critical than the narrow absorption peak at 975 nm. In addition, the beam quality of the Nd:YAG laser, orders of magnitude superior to diode lasers of comparable power, enables easy launching of the pump into the single-mode core of a fiber. The gain-guiding effect obtained in single-mode pumped devices are particularly attractive for pulsed high-power systems, eg LMA fibers.

A 22 cm Er:Yb-fiber was used in the experiment. The cleaved fiber ends were used as cavity feedback. The measured signal spectral width, centered at 1.535 μm was limited by the resolution of the optical spectrum analyzer (Figure 2). The total signal power obtained from this setup was 110 mW at 1.535 nm, with an estimated absorbed pump power of less than 700 mW.

In summary, we have demonstrated a short fiber-laser based on a single-mode Er:Yb co-doped phosphate glass fiber, pumped by a 946 nm Nd:YAG laser. An output power of 110 mW at 1.535 m has been achieved with Fresnel reflection resonator mirrors. Results from an optimized cavity, and a comparison with other Er:Yb fibers will be presented at the conference.

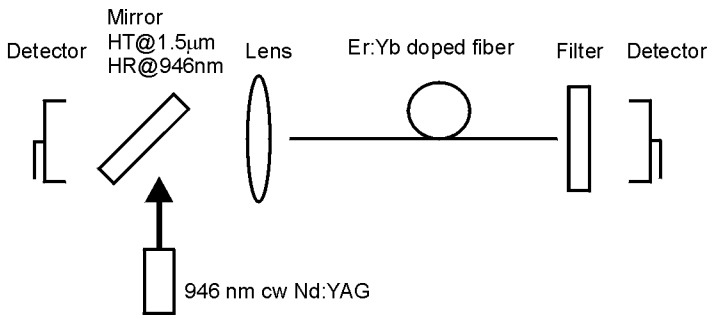

Figure 1. Experimental setup.

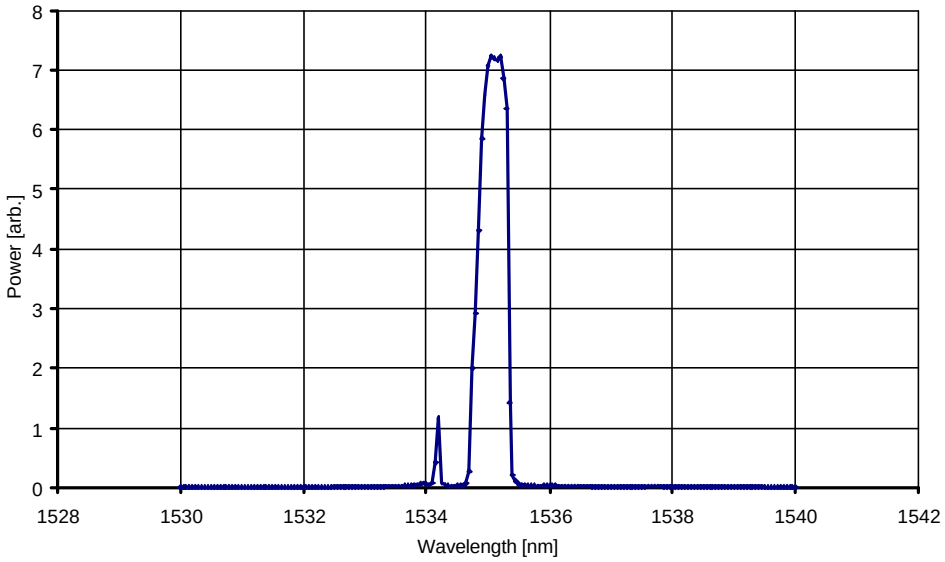

Figure 2. Signal spectrum.

1. R.Wu, *et al*., “New generation high power rare-earth-doped glass fiber and fiber laser”, Opto Southeast 2000, Conference proceedings