Universal manuscript template for Optica Publishing Group journals

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Abstract: not yet

1. Introduction

not yet

2. Experimental setup

2.1. 976 nm amplifier system

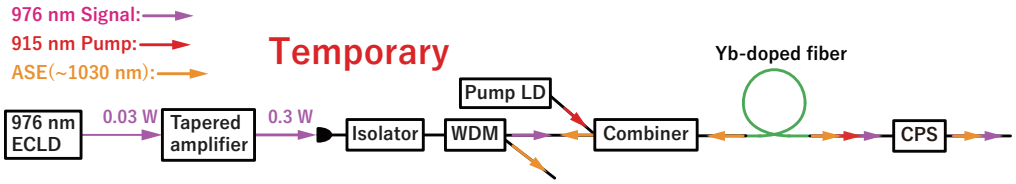

Fig. 1. 976 nm YDFA system.

A schematic of the 976 nm YDFA system is shown in Fig. 1. An external-cavity laser diode(ECLD) at 976 nm is used for the seed laser. The seed laser is pre-amplified by tapered amplifier from 30 mW to 900 mW, and coupled to the YDFA input fiber which is a polarization maintining(PM) fiber with a FPC/AC connector. The seed input of the YDFA is connected to an isolator and a wavelength division multiplexing(WDM) filter, which are used to block return light to the seed laser such as backward ASE. The seed and pump are combined into a double cladding PM fiber, which has a core diameter of 20 µm and a cladding diameter of 125 µm by a pump and signal combiner. The 915 nm radiation for pumping the Yb-doped fiber is generated from fiber-coupled laser diode with an output power of up to 70 W. The combiner output is spliced to the Yb-doped fiber. The Yb-doped fiber nLIGHT Yb1200-25/125DC-PM is used as the gain fiber. The fiber is fixed on top of the water-cooled heatsink with a thermal conductive sheet. The cladding power stripper(CPS) is connected after Yb-doped fiber to remove a residual pump power in the output of Yb-doped fiber. The output of YDFA system collimated by pigtailed collimator is separated into the ASE around 1030 nm and other wavelengths by a filter.

2.2. 987 nm amplifier system

The design of the 987 nm YDFA system is shown in Fig. 2. The 987 nm YDFA has almost the same configuration as the 976 nm YDFA system. The seed laser is composed of ECLD at 987 nm. The maximum seed and pump powers after a combiner are 30 mW and 30 W, respectively.

2.3. 1112 nm amplifier system

The configuration of the 1112 nm YDFA system is shown in Fig. 3. The 1112 nm YDFA system consists of a two-stage amplifier. The fiber laser at 1112 nm(Menlo systems Orange one-2) is

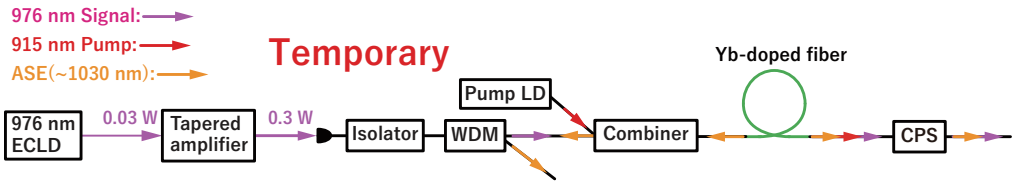

Fig. 2. 987 nm YDFA system.

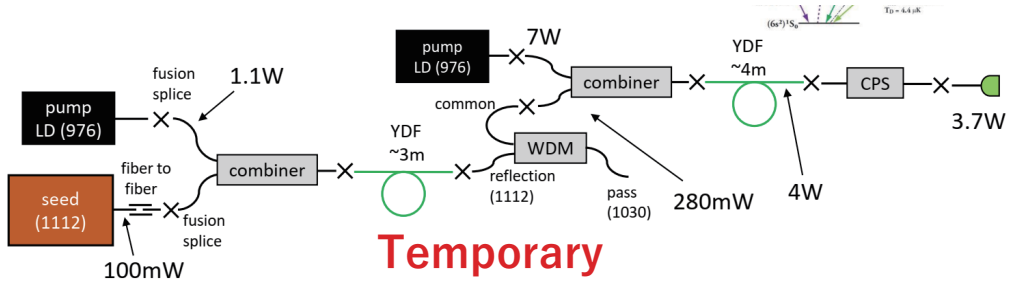

Fig. 3. 1112 nm YDFA system.

used as the seed laser. In the first stage, the seed laser and the pump laser, which is generated by fiber-coupled laser diode at 976 nm with a maximum output of 7 W, are mixed with the first combiner. The first combiner has a signal port, two pump ports, and a common port, which are a single-mode fiber of 5.8/125 µm, multi-mode fibers of 105/125 µm, and a double-cladding fiber 10/125 µm. The seed power at the common port of the first combiner is 80? mW. The Yb-doped fiber(nLIGHT Yb1200-10/125DC) is used as a gain fiber. The length of the Yb-doped fiber is about 1? m. The output from Yb-doped fiber is separated into 1112 nm signal component and ASE component around 1030 nm by WDM, and only the 1112 nm signal component is coupled to the the second amplifier stage. The second Yb-doped fiber is the same one of the first Yb-doped fiber. The about 3? m long doped fiber is coiled to a diameter of 10 cm and fixed inside an aluminum enclosure with thermal conductive sheet. Temperature of the aluminum enclosure is controlled by peltier devices. Output of the second Yb-doped fiber is removed by CPS and collimated by pigtailed collimator.

3. Results and discussion

3.1. 976 nm YDFA

The output power of 976 nm fiber amplifier is shown in Fig. 4. At pump power of 12 W, the gain of 976 nm begins to exceed 1. We achieved 6.7 W of 976 nm at maximum pump power of 68 W which is corresponding to 14.5 dB, but the output decays with time and was reduced by about 10% or more of its original power after 60 minutes. This is likely due to photodarkening caused by the high inversion distribution of Yb ion.

3.2. 987 nm YDFA

3.3. 1112 nm YDFA

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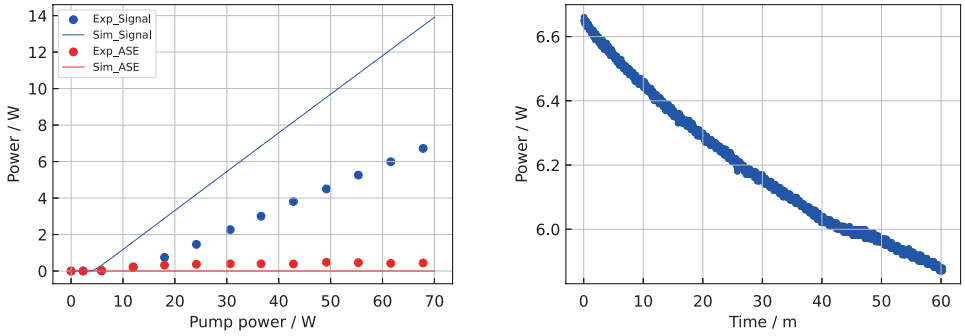

(a) (b)

Fig. 4. Measurement output power of the 976 nm fiber amplifier and results of the simulation.

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```
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\caption{Sample caption (Fig. 2, \cite{Yelin:03}).}
\end{figure}
```

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1. M. Partridge, "Spectra evolution during coating," figshare (2014), http://dx.doi.org/10.6084/m9.figshare.1004612.

5.4. Sample Code Citation

2. C. Rivers, "Epipy: Python tools for epidemiology," figshare (2014) [retrieved 13 May 2015], http://dx.doi.org/10.6084/m9.figshare.1005064.

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Displayed equations should be centered. Equation numbers should appear at the right-hand margin, in parentheses:

$$J(\rho) = \frac{\gamma^2}{2} \sum_{k(\text{even})=-\infty}^{\infty} \frac{(1+k\tau)}{\left[(1+k\tau)^2+(\gamma\rho)^2\right]^{3/2}}. \tag{1}$$

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The commands `\begin{thebibliography}{}` and `\end{thebibliography}` format the section according to standard style, showing the title **References** Use the `\bibitem{label}` command to start each reference.

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Add references with BibTeX or manually. [1–8]

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