Ti:sapphire laser pumped high average power laser crystal Nd:GGG with high efficiency output

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High-quality neodymium doped GGG laser crystals have been grown by Czochralski (Cz) method. Results of Nd:GGG thin chip laser operating at 1.064 μm pumped by Ti:sapphire laser operating at 808 nm were reported. The slop efficiency was as high as 20%.

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In recent years, the application of high-power solid-state laser has been increasing significantly in industrial use and medical science. Desirable spectroscopic properties include large absorption and emission cross-sections, small Stokes shift, and long fluorescence time. Other parameters critical for operation at high average power (HAP) laser include thermo-mechanical, thermo-optical properties of the host crystal, and availability of crystals in large size and good quality[1−3].

The most widely used solid state laser (SSL) crystal now is Nd^{3+}:YAG. But as we know, the Nd:GGG crystal has a series advantages compared with Nd^{3+}:YAG[4−7]: GGG grown core-free up to 15 cm in size and superior optical quality while the YAG single crystal is limited to a few centimeters; the concentration of Nd^{3+} in GGG can be 4% and more, while in YAG it is limited to $< 1.5\%$, and the segregation coefficient of Nd^{3+} in GGG crystals is 0.52 while 0.2 in Nd:YAG crystals. What's more, there is week concentration quenching of Nd^{3+} when it substituting Gd^{3+}. In this letter, we report Nd:GGG thin chip laser operating at 1.062 μm pumped by Ti:sapphire laser operating at 808 nm.

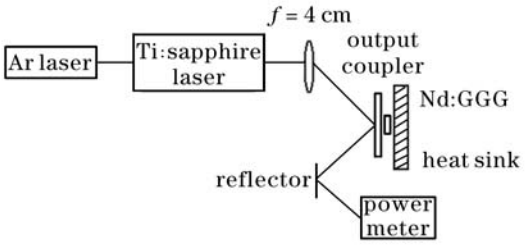

Fig. 1. Experimental setup of the Ti:sapphire laser pumped Nd:GGG thin chip laser.

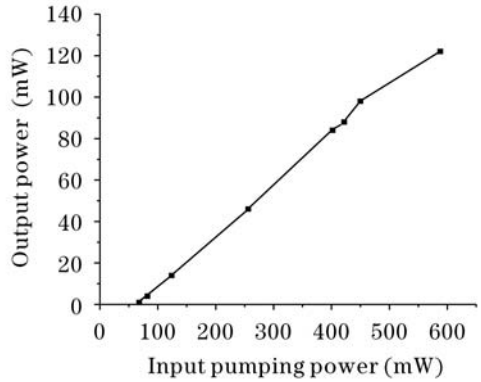

Fig. 2. Relation between the output power and the input pump power.

The experimental setup is shown in Fig. 1. Laser resonator was formed from flat-flat cavity. The Ti:sapphire laser (beam diameter approximately 4 mm) is focused by a length of about 40 mm onto the front side of the cavity. The front side is high transition for the pumping wavelength of 808 nm. The back side is anti-reflection (AR) of 1.062 μm and 808 nm. The size of Nd:GGG thin chip is $7 \times 7 \times 1$ mm^3. The Ti:sapphire laser is operated in the CW mode, and the output laser is in the CW mode.

Figure 2 shows the output power versus input pump power of the high average power laser crystal Nd:GGG laser. Form Fig. 2, we can see that the threshold of pump power is approximately 65 mW, and the slop efficiency is as high as 20%. The laser kept working TEM_{00} at any level of incident pump power, and the output beam did not exhibit any favorite polarization.

In conclusion, we have grown a high quality Nd:GGG crystal and measured its spectra. And also we have presented the diode-pumped laser based on Nd:GGG crystal. Up to 122-mW laser output power was produced near 1062 nm. The slop efficiency is as high as 20%.

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