High power single-crystal fiber CW 946 nm laser and blue generation based on Rubidium-doped PPKTP (orale)

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Blue lasers have numerous applications in spectroscopy, underwater communication and material processing. Direct emission in the blue region can be achieved with laser diodes, with powers up to the watt level [1]. Higher powers require efficient laser operating around 950 nm to be frequency doubled to the blue spectrum, which usually suffer from a lower gain than conventional 1µm lasers. Generally, intracavity frequency doubling set-ups and pulsed operation are used to increase the second harmonic generation efficiency, with output powers up to 4 W in cw[2] and 1.3W in pulsed regime [3]. In the past few years, both lasers materials and non linear crystals have progressed enough to allow the very simple extracavity frequency doubling of continuous wave lasers in periodically poled materials to acceptable powers[4].

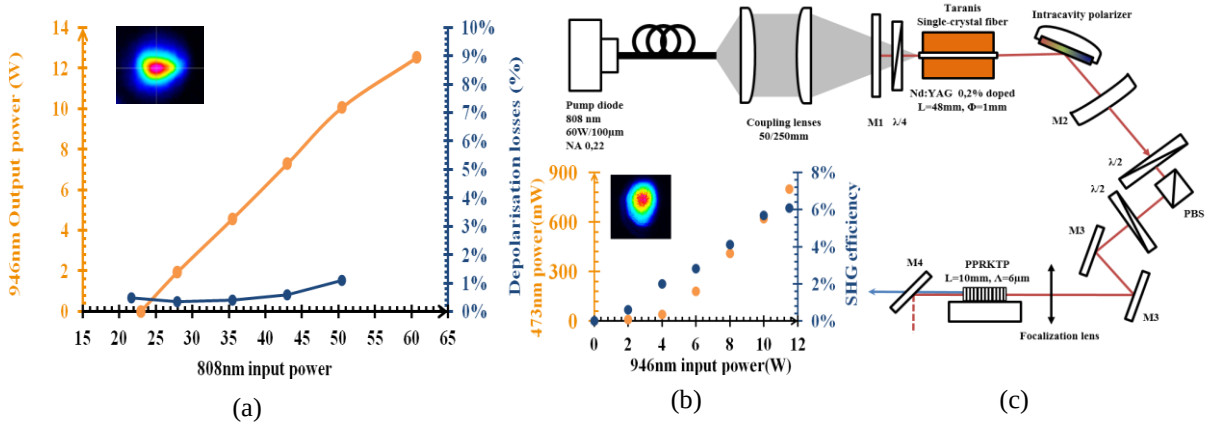

Fig. 1 (a) 946nn laser ouput power and depolarization losses; (b) 473nm power and SHG efficiency; (c) Experimental set-up : the laser cavity is formed by mirrors M1 and M2.M3 are transport mirrors, and M4 is a 946/473 dichroic mirror.

Single-crystal fiber has proved in the past years to be an alternative solution for high power lasers thanks to its excellent thermal management and better pump signal overlap. It has demonstrated up to 30 W of 946 nm with Nd:YAG high power oscillators [5]. We investigate here the potential of Nd:YAG single-crystal fiber oscillator for high power, continuous wave and polarized laser at 946 nm (fig1.c). We demonstrate a polarized laser emitting 11.5 W at 946 nm (fig1.a) with good beam quality (M^2<1.7) and very good stability over 2 hours.

We then show that efficient extracavity conversion is possible in a 10mm long, periodically poled (Λ=6.03µm), flux grown, rubidium-doped KTP (PPRKTP) with up to 800mW (fig1.b) of measured output at 473nm (M^2<1.8), whereas regular SHG crystals (LBO and BiBO) delivers less than 30mW. However, in the blue there is substantial absorption in KTP which leads to temporal instabilities at highest power levels, but stable output could be reached at more than 250mW of blue power.

To the best of our knowledge, this is the first time that a polarized output of more than 10 W at 946 nm has been reported. It is also the highest power ever obtained by extracavity frequency doubling a cw 946 nm laser into the blue region.

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