FREQUENCY STABILIZATION OF A NOVEL 1.5 μm Er-Yb BULK LASER TO A ^{39}K SUB-DOPPLER LINE AT 770.1 nm

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ABSTRACT

The second harmonic output at 770.1 nm of a novel and compact Er-Yb:glass laser was frequency stabilized against the sub-Doppler linewidth of a crossover line in the ^{39}K $4S_{1/2}$-$4P_{1/2}$ transition as obtained by saturation spectroscopy. Efficient frequency doubling, with a conversion efficiency of ~220 %W^{-1}, and with second harmonic power in excess of 15 μW, was achieved in a waveguide made in a periodically poled lithium niobate crystal. As measured through the analysis of the closed-loop error signal, a laser frequency instability of ~200 Hz was obtained; the Allan standard deviation of the frequency samples was below 4×10^{-12}, for integration times τ between 100 ms and 100 s, and reached a lowest floor level of 8×10^{-13} for 20 s $\leq \tau \leq$ 100 s. The measured frequency noise spectral density was in good agreement with the analysis performed in the time domain. Compared to previously published data for stabilized solid-state laser sources in this wavelength region, these results represent a significant improvement in the frequency stability.

Index Terms—Erbium, solid (state) laser, frequency conversion (doubling), frequency stability, 1.5 μm, potassium.