Tunable, single-frequency Nd:YVO4 red laser

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Single-frequency cw lasers in the visible region are very interesting for high precision spectroscopy as alternative to dye lasers. In order to obtain the red emission in 671nm, the second harmonic generation of the 1342nm transition using Nd:YVO_4 crystal was demonstrated. To avoid thermal problems we preferred to use a low-doped gain media, with 0.15at% of neodymium. With an asymmetric bow-tie cavity, the 1.3μm transition was studied varying the transmission of one mirror. The unidirectional operation was maintained using a diode consisting of a Brewster-cut TGG Faraday rotator rod and a zero-order wave plate. Using a 2% transmission output mirror, 1.7W was obtained at 1342.5nm without etalon inside the cavity.
For the second harmonic generation, all the mirrors were broadband HR-coated (R>99.8% in the range 1300-1350nm, with T$\sim$90% in the 650-810nm range) and the type-I critically phase-matched BiBO crystal was inserted between the two curved mirrors (ROC=100mm), in the smallest waist of the cavity ($\sim$ 50μm). In the red emission, single frequency operation at gain center wavelength was obtained with more than 620mW without an etalon inside the cavity, but with frequent mode-hops. In order to obtain a stable and tunable laser, a thin fused silica etalon, with reflectivity of 40%, was used at the cost of increased losses. With this configuration we could achieve more than 350mW at 671.2nm, and wavelength tuning over $\Delta\lambda_{IR}$ $\sim$3nm and $\Delta\lambda_{red}$ $\sim$1.25nm.