COMPACT TUNABLE LiF COLOR CENTER LASER SYSTEM

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The laser utilizing LiF crystal with F₂⁺ color centers (CC) is an efficient and reliable source of tunable radiation which covers a broad near IR spectral region that is very important for scientific applications and allows using CC lasers for spectroscopic investigations of rare earth doped laser materials [1]. The CW operation of LiF:F₂⁺ CC laser is complicated due to short lifetime of F₂⁺ CC (55 ns), strong negative thermal lens and the presence of an additional quadruplet energy level with long lifetime [2]. Modern laser system should have a compact size with low power consumption, that’s why the aim of this paper was to develop a quasi CW high peak power oscillation laser system based on LiF:F₂⁺ CC laser pumped by a compact LD-pumped acousto optically Q-switched Nd:YVO₄ laser.

The key element of the system was LiF:F₂⁺ CC active element with 8x20 aperture and 40 mm long with the Brewster cut faces with initial absorption 0.2 cm⁻¹ at 1064 nm. The contrast value determined as a ratio of active to passive losses was as high as 22 that was the evidence of the high quality of the active element. Due to high average powers the LiF CC crystal was placed in the cooper block cooled with a stabilized at T=20°C water. A compact quasi CW acousto optically Q-switched Nd³⁺:YVO₄ laser with 1064 nm oscillation wavelength was used as a pump source. It was excited by the 880 nm fiber-coupled diode laser. The output power of Nd:YVO₄ laser was up to 15 W at 30 kHz pulse repetition rate. The pulse energy and duration were 500 μJ and 20±2 ns.

The tunable color center laser cavity was composed with an entrance dichroic mirror and diffraction grating and utilized a longitudinal pumping scheme. The CC laser cavity was compact, about 60 mm distance between the mirror and diffraction grating. The diffraction efficiency to the first order was measured to be 77% that was close to the optimal reflectivity of CC laser output coupler. The zero order of diffraction was used as an output of the cavity. The oscillation wavelength was tuned by fine changing the incident angle. The tuning curve of CC laser pumped by 1.6 W power from Nd:YVO₄ laser is presented in Fig.1. The efficiency of CC laser in the maximum of the tuning curve was 10% and the tuning range spread from 1.108 to 1.290 μm wavelength. The short wavelength part of the tuning curve had a sharp reduction due to the reflectivity edge of the mirror M3. The spectral width of the oscillation spectrum was less than 1 nm that was determined by the resolution of the spectrum analyzer. The narrowline oscillation had no evidence of broadband background even at the edges of the tuning curve that is important for practical applications.

Thus, the efficient LiF:F₂⁺ color center laser pumped by a compact LD-pumped Nd:YVO₄ acousto optically Q-switched laser was developed. The narrow line tunable from 1.1 to 1.290 μm laser radiation with 10% conversion efficiency in the maximum was achieved under pumping with 1.6 W average pump power and 30 kHz pulse repetition rate. The average output power as high as 230 mW was reached.

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**Fig.1. Tuning curve of narrow line oscillation of LiF:F₂⁺ CC laser pumped by Nd:YVO₄ laser with 1.6 W average power.**