

THE IDENTIFICATION OF THE COMPONENTS FOR TI:SAPPHIRE LASER OSCILLATOR

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ABSTRACT

The aim of this report was to identify the components to be employed in the development of Ti:sapphire laser. The oscillator was utilized to produce ultrashort laser pulse. Ti:sapphire crystal was incorporated as the active medium. This crystal was excited by DPSS laser. The cavity was aligned by a set of mirror. A Prism was to compensate the negative dispersion. SESAM mirror was utilized to modulate or compress the beam to short pulses.

Keywords: Ultrashort, Ti:sapphire, SESAM, prisms, compensate, oscillator

INTRODUCTION

The invention of the laser in 1960 stimulated renewed interest in optical physics and gave rise to a number of new research fields. One of them was the field of ultrafast optics, which had the beginning in the mid-1960s with the production of nanosecond (10^{-9} s) pulses by the first mode-locked laser. Rapid progress in ultrashort pulse generation with Ti:Sapphire laser began with the first demonstration of Kerr lens mode locking (KLM) [1]. The range of application of ultrashort Ti:sapphire laser is constantly broadening and penetrates increasingly into industrial technologies and medical technique [2]. Most applications of ultrashort sources can be grouped into four different categories which benefit from different properties of ultrashort laser pulses. First, in the time domain the ultrashort pulse provides excellent time resolution in measurements; second, the relatively high peak power at low average power is important to reduce thermal effects in material and especially medical tissue processing; third, the short coherence length at high average power improves the signal:noise ratio in optical tomography and other interferometric measurements; fourth the broad coherent spectrum can be filtered to obtain different pulse sequences [3].

METHODOLOGY

The critical part in this development is in the Ti:sapphire crystal itself. Ti:Sapphire is probably the most successful laser medium used in generation of ultrafast laser because of its broad gain bandwidth (approximately 200 nm FWHM) and excellent mechanical and thermal properties [4,5]. The dimension of crystal employed is 3 mm × 5 mm × 5 mm in slab shape. Both end of the crystal was cut at Brewster angle which is essential to minimize reflection losses of the pump [5]. Titanium atom are the impurities that are doped in Aluminium oxide (Al_2O_3). Three different percentages of the doping namely; 0.06% wt, 0.15% wt and 0.25% wt were utilized. End pumping technique using Diode Pumped Solid State (DPSS) laser was used to excite the laser medium [6]. The DPSS laser has maximum energy of 2.6 W and 9 mm beam spot. The beam size was reduced by using beam reducer. The cavity alignment using a set of mirrors with reflection of larger

than 99.8% in the range 735 to 835 nm was used. DPSS laser beam was focus on to the crystal to ensure high intensity beam exposed the crystal. The main problem to produce the ultrashort pulse is the dispersion. Dispersion can cause the different wavelength of light to experience different phase shift [7]. This result the shorter wavelength to lag behind the longer wavelength. The main source of dispersion is the laser crystal itself. Negative dispersion mirror or prism can be used to compensate this problem. 95 % mirror was used as an output coupler. In this case only 5 % of the beam will be lase out and the rest will be reflected and amplified in the cavity. Semiconductor Saturable Mirror (SESAM) is employed as an element in producing ultrashort pulse via passive mode locking technique [8]. The schematic of the whole laser oscillator is depicted in Figure 1 and the entire components for the construction are shown in Figure 2.

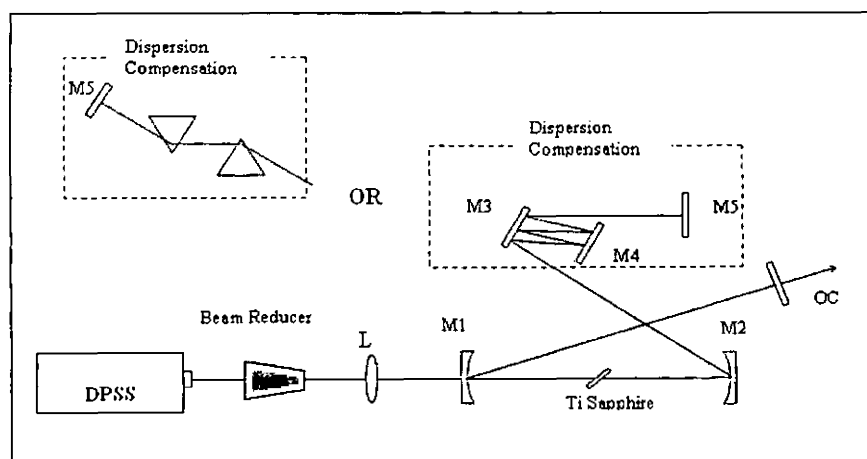
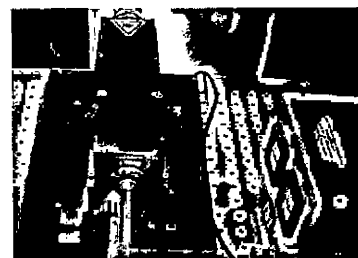


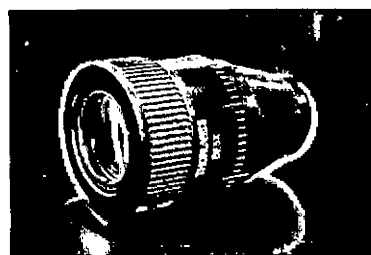
Figure 1: The schematic of the whole laser oscillator



a) Ti:Sapphire Crystal



b) Diode Pumped Solid State Laser



c) Beam Reducer



d) Focusing Lens

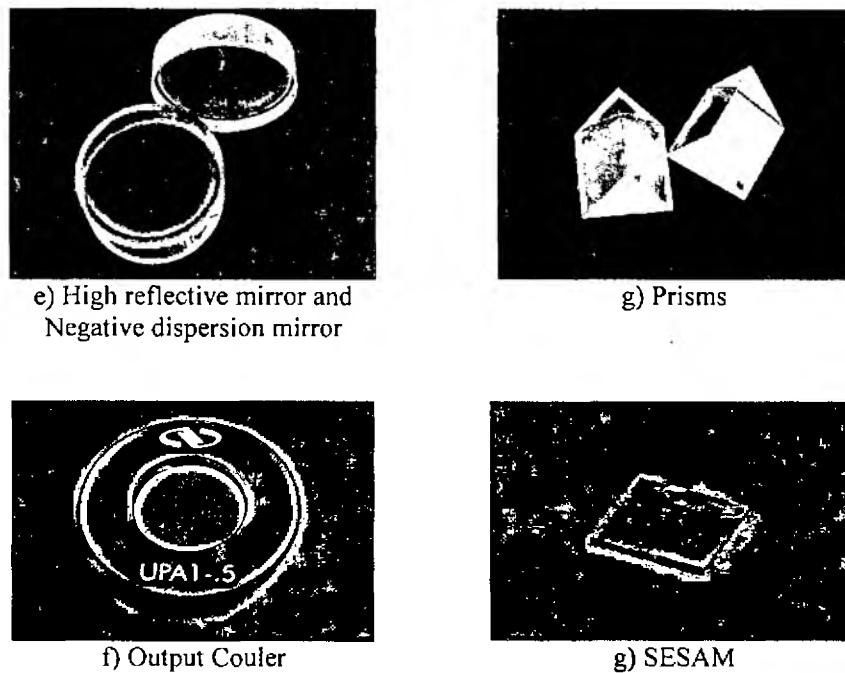


Figure 2: The entire component for the construction

CONCLUSION

The components of Ti:sapphire laser oscillator were successfully identified. It consists of Ti:sapphire crystal, DPSS laser, beam reducer, focusing lens, High reflective mirrors, negative dispersion mirrors, prisms, output coupler and SESAM.

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