High-power diffraction limited laser systems oscillating in middle infrared spectral range on strontium atomic self-terminating transitions

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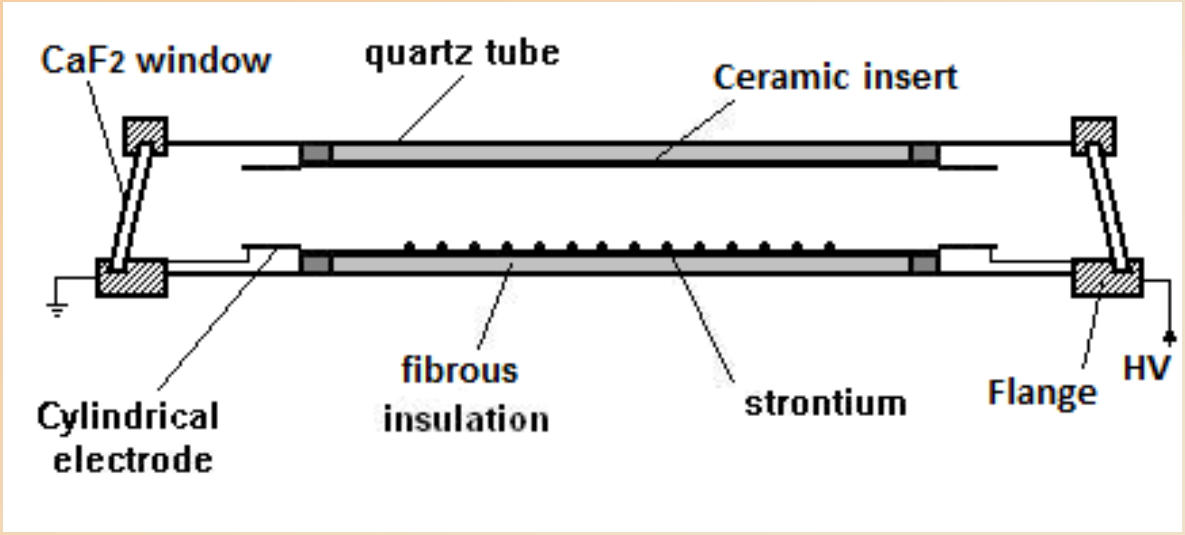
Introduction

The discovery that laser radiation at 6.45 μm delivered by tunable laser sources provides efficient and precise laser ablation of soft and hard tissues with minimal thermal collateral damage inspires investigations on strontium and strontium halide vapor lasers. Except for energy laser characteristics, efficiency and accuracy of high-precision microprocessing of various materials including soft and hard tissues through laser ablation crucially depend on laser beam quality that is quantitatively determined with beam propagation factor, so called times-diffraction-limited factor, which is defined with the ratio of the laser beam divergence and the diffraction-limited divergence of a perfect Gaussian beam with the same beam diameter.

Aims

1. By means of all-solid-state power supply based on the new innovative bipolar HV excitation scheme, to develop a compact table-top 10-W Sr vapor laser;
2. To develop diffraction-limited sealed-off Master Oscillator – Double-Pass Amplifier (MO–DPA).

Experimental setup



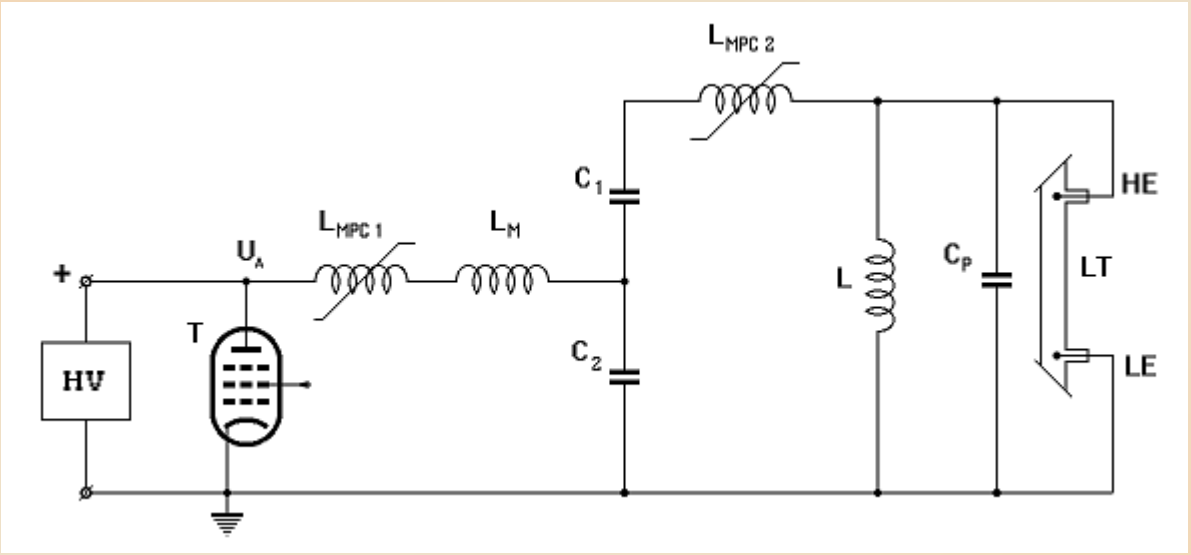


Fig. 1. Schematic diagram of laser tube and electrical pulsed excitation scheme.

Experimental results

Average output power – 29 W

Laser pulse energy – 2.9 mJ

Experimental setup

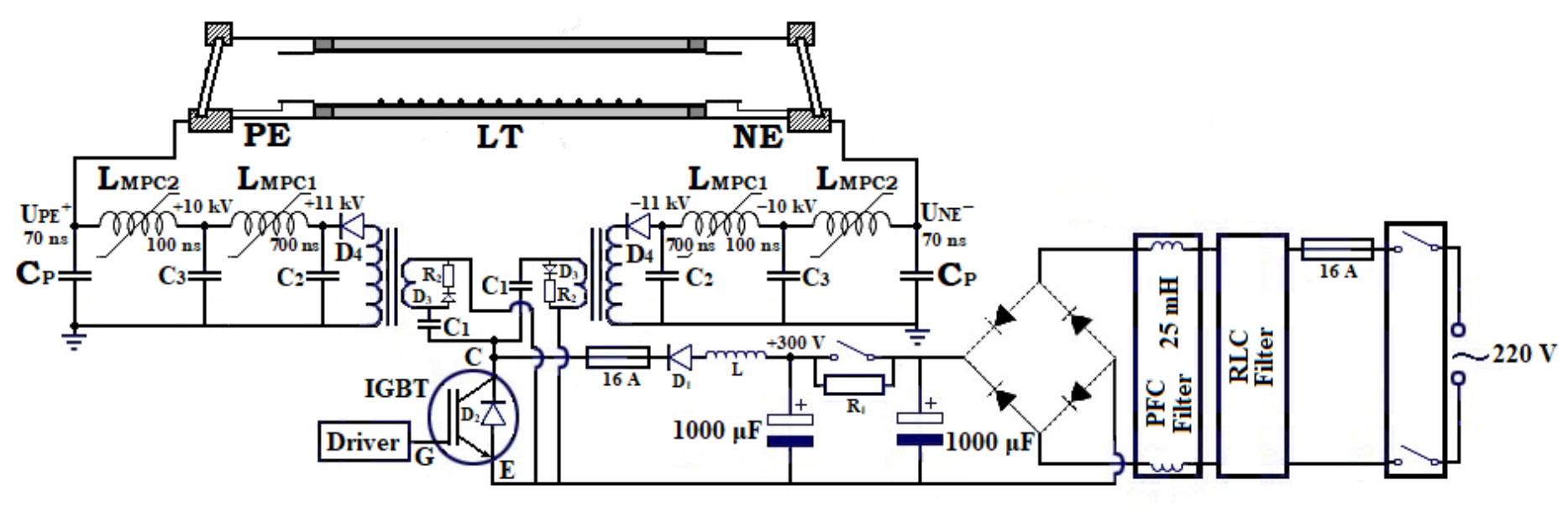


Fig. 2. Schematic diagram of all-solid-state bipolar HV power supply.

Experimental results

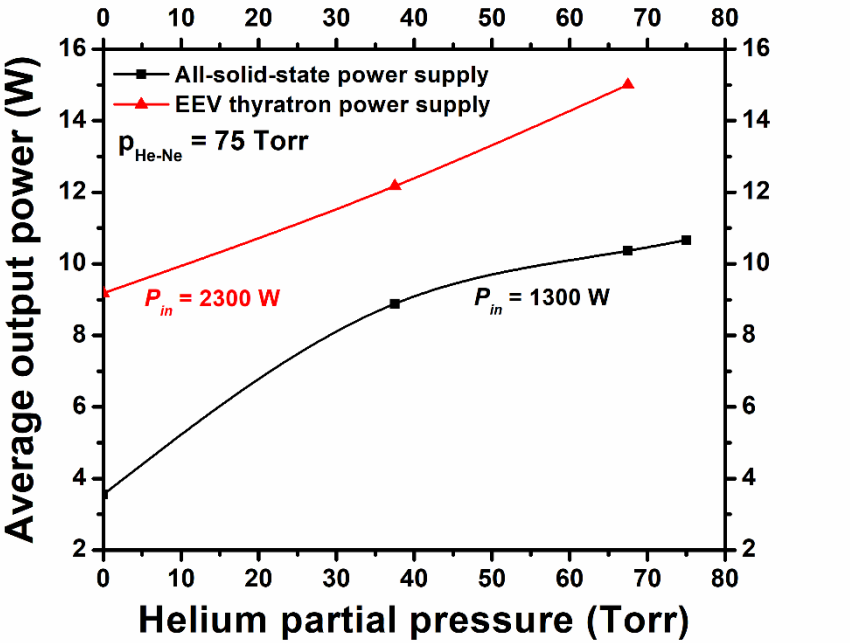


Fig. 3. Average laser power as a function of helium partial pressure.

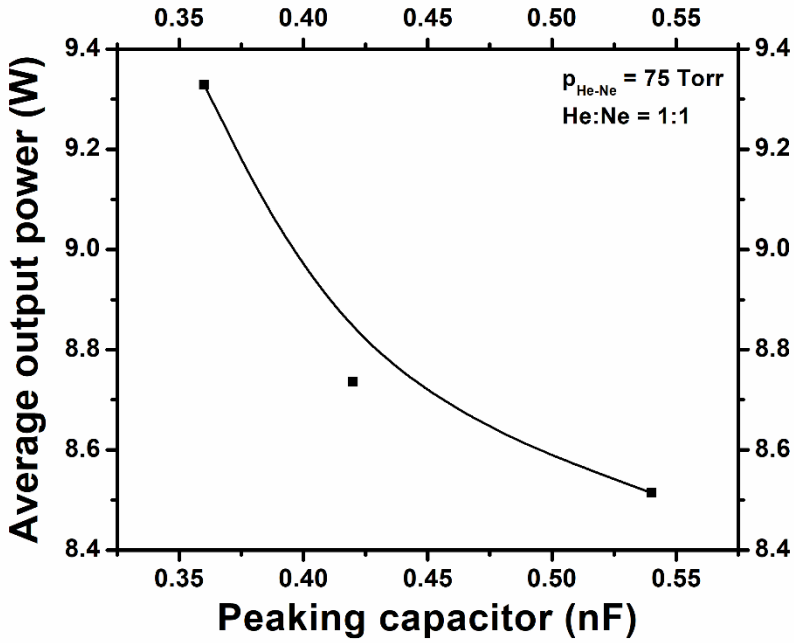


Fig. 4. Dependence of average laser power on peaking capacitor.

Experimental setup

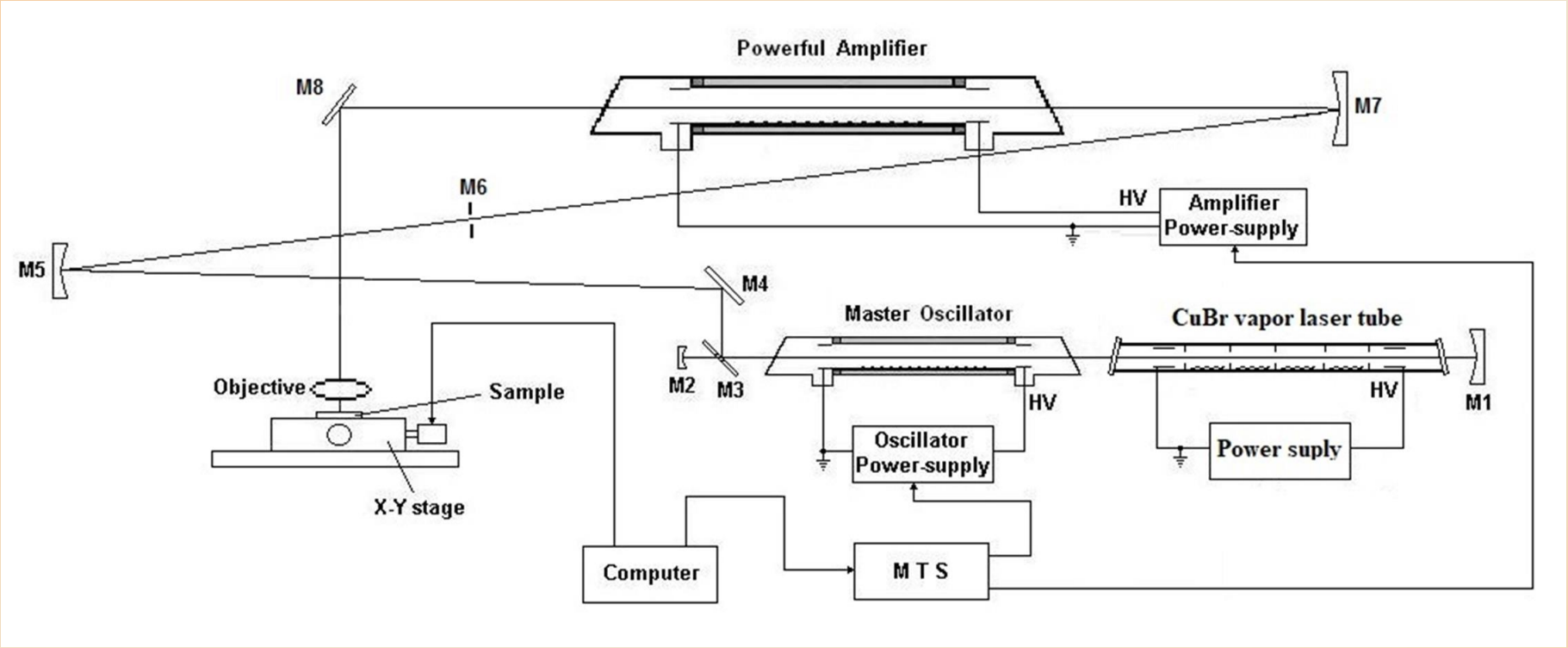


Fig. 5. Schematic diagram of investigated MO–PA system.

Table 1. Parameters of optical elements, namely mirrors, lenses, diaphragms.

Optics	M1	M2	M3		M4	M5	M6	M7	M8	Objective
Focal length (cm)	200	12	∞	Orifice diameter 0.8 mm	∞	86	Orifice diameter 0.5 mm	159	∞	15

Experimental setup

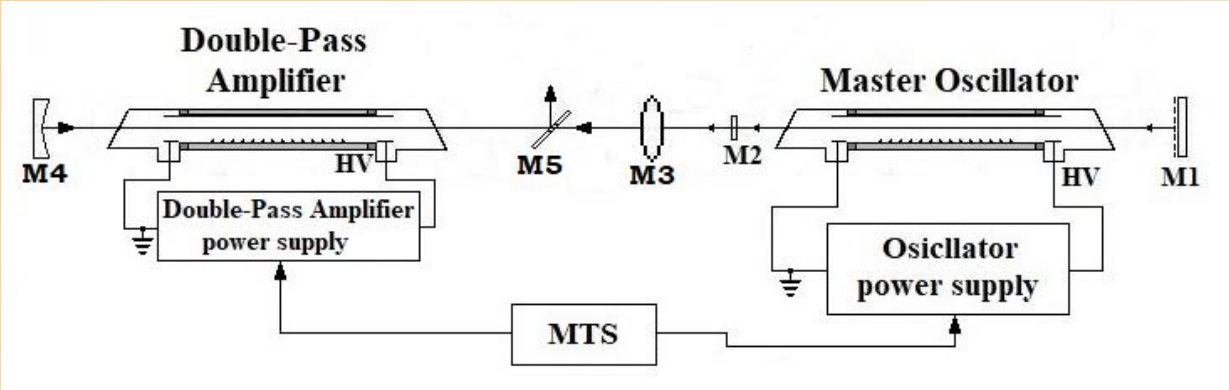


Table 2. Parameters of optical elements, namely mirrors, lenses, diaphragms.

Optics	M1	M2	M3	M4	M5	
Focal length (cm)	∞	∞	50	200	∞	0.8-mm orifice

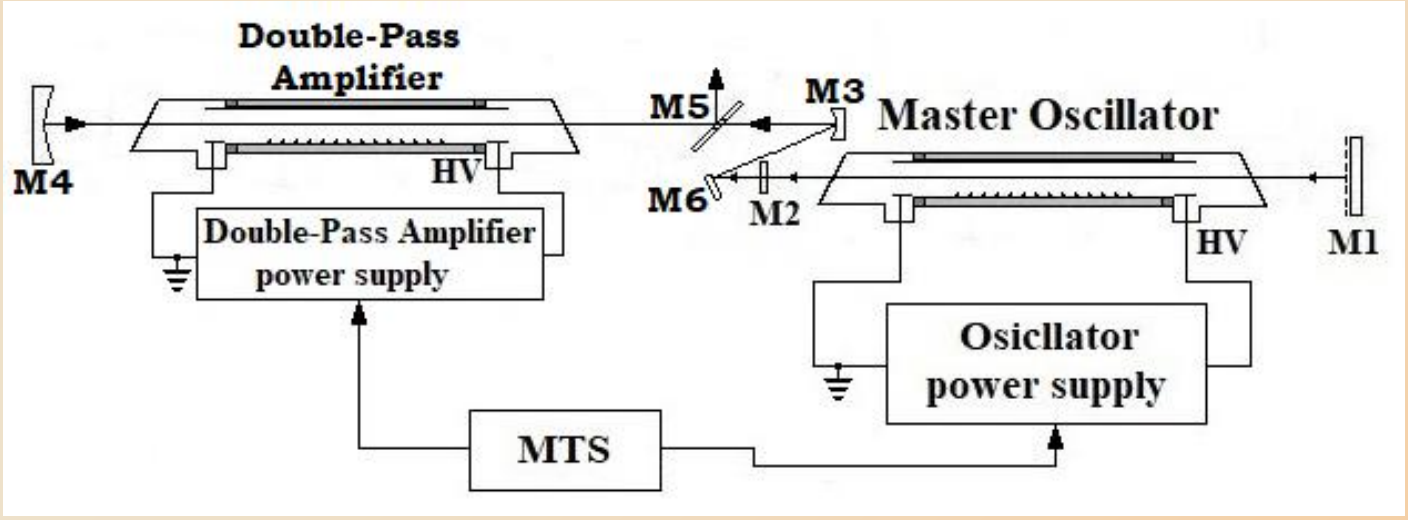


Fig. 6. Schematic diagram of investigated MO–DPA system.

Conclusions

1. By means of all-solid-state power supply based on the new innovative bipolar HV excitation scheme, to develop a compact table-top 10-W Sr vapor laser.
2. A diffraction-limited sealed-off Master Oscillator – Double-Pass Amplifier (MO–DPA) is developed.

Acknowledgements

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