Femtosecond Laser Writing in Silica Glasses.

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Introduction

In the present work, we demonstrate an experimental study of local micro modification produced by 1030 nm-wavelength high-peak power femtosecond pulses in silica glasses.

Experimental setup

The experimental setup that was used for modifications is schematically shown in Fig. 1. The laser, operating at a wavelength of 1030 nm with a pulse duration of 500 fs at a repetition rate of 225 kHz, was produced by FiberLast. The pulse energy is Ep = 4 μJ.

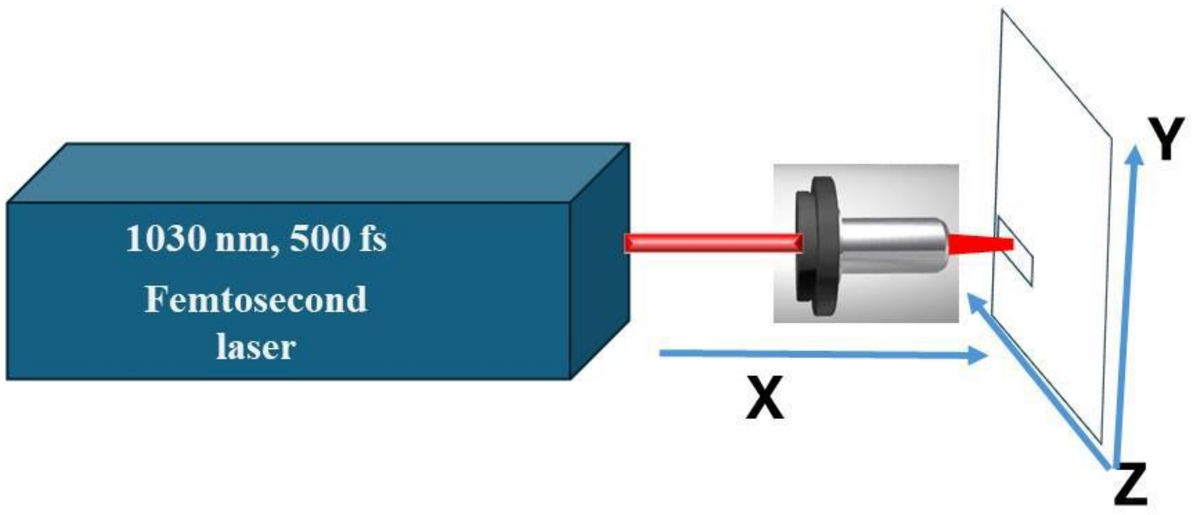

Fig. 1. A typical femtosecond laser setup for fabricating surface/subsurface structures in silica glasses.

The surface structures (Fig. 2 a) were created on standard window glass using the simple direct record technique by the scanning system with a 100 mm focal length. Since a thin film of iron covers this glass, the modification process does not need a strong focus, and different shape structures can be created (Fig. 2 a, inset).

In a transparent material, permanent damage is produced if nonlinear absorption mechanisms deposit enough laser energy into the sample. Controlled subsurface modifications (Fig. 2 b, c) were realized by the laser beam that is focused inside the sample by an aspheric lens with 0.5 NA that corresponds to a focal spot of 2.1 μm. Each modified section was created by translating the sample in the Y--Z direction. Changing the step of the Y direction produces a grating period. The laser-written structures were analyzed with the microscope. The propagation of green light through the created structure was tested. The diffraction characteristics were investigated (Fig. 2 d).

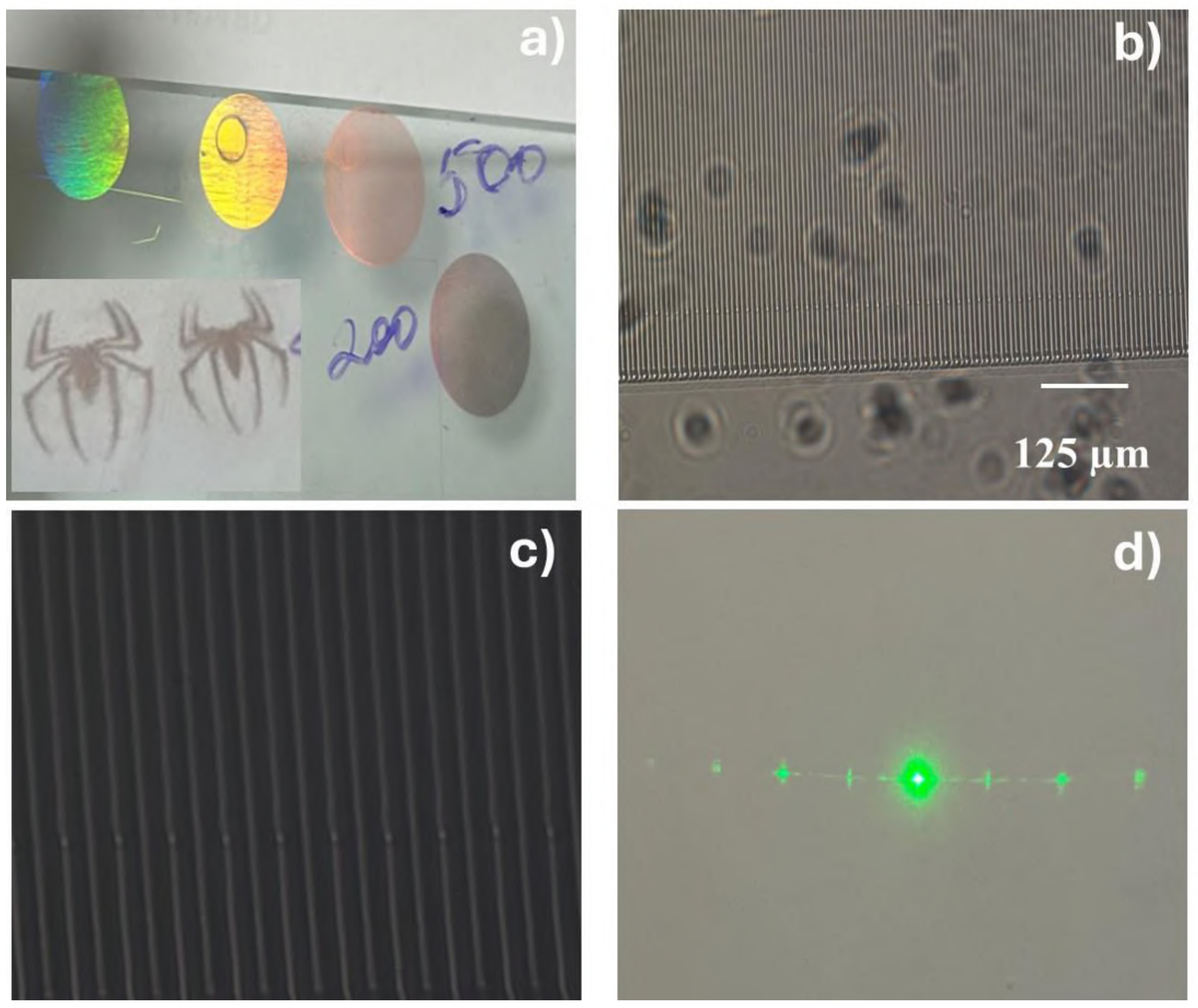

Fig. 2. (a) Surface modification of silica glass. (b, c) Periodic structures inside glass. (d) Propagation of green light through the created structure (grating).

Output laser parameters

Central Wavelength	Average Power	Pulse Duration	Repetition Rate
1030 nm	850 mW	~500 fs	~225 kHz

Conclusions

We developed a stable commercial 500 fs laser system at 1030 mm. Laser-induced periodic surface/subsurface structures were formed on silica glasses upon irradiation by ultrashort laser pulses.