Claims

1. A system for laser processing a transparent material, comprising:
the transparent material;
a laser source (500) configured to provide a laser beam comprising bursts of laser pulses;
one or more focusing elements (520) for focusing said laser beam relative to said transparent material;
said laser beam and said one or more focusing elements (520) producing a sufficient energy density within said transparent material (522) to form a continuous laser filament therein, **characterized in** that said one or more focusing elements (520) include an uncorrected or aberrated optical focusing element, said uncorrected or aberrated optical focusing element is configured to externally focus said laser beam relative to said transparent material (522) to form a beam waist at a location that is external to said transparent material (522), and that
said optical focusing element is further configured to provide a weakly focused laser beam distributed within said transparent material (522) producing a spatially extended and spatially homogenous filament in said transparent material (522) and that said continuous laser filament is formed within said transparent material.

2. The system for laser processing a transparent material according to claim 1, **characterized by** means (505) for varying a relative orientation between said laser beam and said transparent material (522), especially said means (505) are formed by a motorized mechanism for varying a

relative position between said laser beam and said transparent material (522) .

3. The system for laser processing a transparent material according to claim 1 or 2, **characterized by** a control and processing unit (550) for controlling said laser source (500), especially operatively coupled to said means (505) for varying said relative position between said laser beam and said transparent material (522) .

4. The system for laser processing a transparent material according to claim 2, **characterized in** that said control and processing unit (550) is configured to control the relative position between said laser beam and said transparent material (522) for forming an array of continuous laser filaments within said transparent material (522) .

5. The system for laser processing a transparent material according to claim 1, **characterized in** that said one or more aberrated optical elements comprise a normal field-corrected scan lens, a corrective window or an aspheric plate configured to produce an aberrated laser beam.

6. The system for laser processing a transparent material according to anyone of the preceding claims, wherein said laser beam has an incident spot diameter on said transparent material (522) and a continuous laser filament diameter within said transparent material (522); and wherein a critical ratio is defined as the ratio of said incident spot diameter of said laser beam on said transparent material (522) to said continuous laser filament diameter within said transparent material (522) ;
characterized in that the optical focusing element is configured such that said laser is focused such that said critical ratio is between approximately 1 and 1000.

7. The system for laser processing a transparent material according to anyone of the preceding claims 3 to 6, **characterized in** that said control and processing unit(550)
- is configured to vary the pulse wavelength of said laser source (500) and/or varies pulse-to-pulse separation within a burst of said laser source (500) and/or
- is configured to vary pulse energy of said individual pulses within a burst of said laser source (500) and/or

- is configured to vary the burst repetition rate of said laser source (500) and/or
- is configured to vary polarization of said laser source.

8. The system for laser processing a transparent material according to anyone of the preceding claims 2 to 7, **characterized in** that said means (505) for varying the relative position between said laser beam and said transparent material (522) is configured to maintain constant spacing between continuous filaments formed within said transparent material (522) .

9. The system for laser processing a transparent material according to anyone of the preceding claims, **characterized in** that means for auto-focusing of said laser beam in real-time are provided.

10. The system for laser processing a transparent material according to anyone of the preceding claims 3 to 9, **characterized in** that at least one optical monitoring device configured for optically monitoring said continuous laser filaments;
said control and processing unit (550)
- is operatively coupled to said at least one optical monitoring device and/or
- is configured to determine one or more parameters associated with formation of said continuous laser filaments based on images or signals provided by said at least one optical monitoring device; and/or
- is configured to actively control the formation of the continuous laser filaments according to at least one of the parameters.

11. The system for laser processing a transparent material according to claim 10, **characterized in** that said one optical monitoring device is located above, below, adjacent to said transparent material (522) .

12. The system for laser processing a transparent material according to claim 10 or 11, **characterized in** that said at least one optical monitoring device comprises:
an optical detector configured to detect optical radiation emitted during said filament formation process;
said control and processing unit (550) is configured to process signals from said optical detector to

determine one or more parameters associated with said continuous laser filaments.

13. The system for laser processing a transparent material according to claim 10 to 12, **characterized in** that said one or more of said parameters are selected from the group consisting of filament depth, filament size, filament position, and pattern fidelity.

14. The system for laser processing a transparent material according to anyone of the preceding claims, wherein when said transparent material (522) has a surface with a complex spline profile in two, two and half or three dimensions; the system is configured to
control said relative position between said laser beam and said transparent material (522) and control the orientation of said laser beam such that said array of continuous laser filaments is formed within said transparent material (522)
- singulate or cleave said transparent material (522) resulting in the formation of a tilted, straight or chamfered edge and/or
- to control, for the purpose of singulation, said laser pulses to do laser ablation for material removal on the same in a second beam delivery.

15. The system for laser processing a transparent material according to anyone of the preceding claims, **characterized by** a second laser source to release the array of continuous laser filaments by application of a heat source having a sufficient temperature differential from the transparent material to cause separation at the scribed/cut location.

16. The system for laser processing a transparent material according to claim 15, **characterized in** that said laser source (500) is a CO_2 laser, a solid state laser or a fiber laser.

17. The system for laser processing a transparent material according to anyone of the preceding claims, **characterized in** that the optical train of the system includes one or more optical components for collimating the beam prior to focusing, in order to accommodate a variable path length between the distributed focusing element and the laser source; and that
the numerical aperture of the collimating components is between approximately 0.1 and 0.88 NA.