WHAT IS CLAIMED IS:

~~1. An article comprising:~~

~~a substrate having a plurality of laser-drilled through-holes continuously extending from a first surface of the substrate to a second surface of the substrate, opposite the first surface of the substrate, wherein:~~

~~the plurality of laser-drilled through-holes have a diameter of 10μm or greater;~~

~~a spacing between adjacent etched through-holes of 30μm or greater;~~

~~the plurality of laser-drilled through-holes comprise an opening in the first surface, an opening in the second surface, and a waist located between the opening in the first surface and the opening in the second surface;~~

~~a diameter of the waist is at least 75% of the diameter of the opening in the first surface or the opening in the second surface; and~~

~~a difference between a diameter of the opening in the first surface and a diameter of the opening in the second surface is 3.5μm or less.~~

~~2. The article of claim 1, wherein the substrate is transparent to at least one wavelength in a range from 390 nm to 700 nm.~~

~~3. The article of claim 1, wherein the substrate is glass.~~

~~4. The article of claim 1, wherein the substrate has a thickness in a range from 50 μm to 100 μm.~~

~~5. The article of claim 1, wherein the diameter of the waist is at least 80% of the diameter of the opening in the first surface or the opening in the second surface.~~

~~6. The article of claim 1, wherein the plurality of laser-drilled holes contain an electrically-conductive material.~~

1~~7~~. A method for forming a through-via in a substrate, the method comprising:

providing a substrate having a first surface and a second surface opposite the first surface; and

directing, during a drilling period ~~less~~ having a duration less than 100μs, a focused beam of laser pulses into the substrate at a location through the first surface of the substrate and, subsequently, through the second surface of the substrate,

wherein the focused beam of laser pulses has a wavelength to which the substrate is at least substantially transparent,

wherein an optical intensity of the focused beam of laser pulses at the substrate is less than an optical breakdown intensity of the substrate,

wherein the focused beam of laser pulses has a Gaussian energy distribution,

wherein the focused beam of laser pulses has a pulse repetition rate greater than 5 MHz, and

wherein laser pulses within the focused beam of laser pulses have a pulse width greater than 200 fs~~.~~, and

wherein the focused beam of laser pulses is characterized by a pulse repetition rate, a peak optical intensity at the substrate and an average power at the substrate sufficient to:

melt a region of the substrate near the second surface, thereby creating a melt zone within the substrate;

propagate the melt zone toward the first surface; and

vaporize or boil material of the substrate and located within the melt zone.

2~~8~~. The method of claim 1~~7~~, wherein the substrate is at least substantially transparent to at least one wavelength in the ultraviolet, visible or infrared regions of the electromagnetic spectrum.

3~~9~~. The method of claim 2~~8~~, wherein the substrate is at least substantially transparent to at least one wavelength in the visible region of the electromagnetic spectrum.

4~~10~~. The method of claim 2~~8~~, wherein the substrate is at least substantially transparent to at least one wavelength in the infrared region of the electromagnetic spectrum.

5~~11~~. The method of claim 1~~7~~, wherein the substrate is glass.

6~~12~~. The method of claim 1~~7~~, wherein the substrate is sapphire.

7~~13~~. The method of claim 1~~7~~, wherein the substrate is a silicon die.

8~~14~~. The method of claim 1~~7~~, wherein the substrate is a GaN die.

9~~15~~. The method of claim 1~~7~~, wherein the focused beam of laser pulses has a pulse repetition rate greater than 25 MHz.

10~~16~~. The method of claim 9~~15~~, wherein the focused beam of laser pulses has a pulse repetition rate greater than 40 MHz.

11~~17~~. The method of claim 10~~16~~, wherein the focused beam of laser pulses has a pulse repetition rate greater than 300 MHz.

12~~18~~. The method of claim 11~~17~~, wherein the focused beam of laser pulses has a pulse repetition rate greater than 500 MHz.

13~~19~~. The method of claim 10~~16~~, wherein laser pulses within the focused beam of laser pulses have a pulse width less than 50 ps.

14~~20~~. A method for forming a through-via in a substrate, the method comprising:

providing a substrate having a thickness in a range from 30 μm to 150 μm and having a first surface and a second surface opposite the first surface; and

directing a focused beam of laser pulses into the substrate through the first surface of the substrate and, subsequently, through the second surface of the substrate,

wherein the focused beam of laser pulses has a wavelength to which the substrate is at least substantially transparent;

wherein an optical intensity of the focused beam of laser pulses at the substrate is less than an optical breakdown intensity of the substrate;

wherein the focused beam of laser pulses has a Gaussian energy distribution;

wherein the focused beam of laser pulses has a pulse repetition rate, a peak optical intensity at the substrate and an average power at the substrate driving a cumulative heating effect to melt a region of the substrate irradiated by the focused beam of laser pulses; and

wherein laser pulses within the focused beam of laser pulses have a pulse width,

wherein the peak optical intensity, pulse repetition rate, average power and pulse width are selected such that the through-via is formed in less than 40 μs.

15~~21~~. The method of claim 14~~20~~, wherein the peak optical intensity, pulse repetition rate, average power and pulse width are selected such that the through-via is formed in less than 30 μs.

16~~22~~. The method of claim 15~~21~~, wherein the peak optical intensity, pulse repetition rate, average power and pulse width are selected such that the through-via is formed in less than 20 μs.

17~~23~~. The method of claim 16~~22~~, wherein the peak optical intensity, pulse repetition rate, average power and pulse width are selected such that the through-via is formed in less than 10 μs.

18~~24~~. The method of claim 15~~21~~, wherein the peak optical intensity, pulse repetition rate, average power and pulse width are selected such that the through-via is formed in a range from 5 μs to 15 μs.

19~~25~~. A method for forming a through-via in a substrate, the method comprising:

providing a substrate having a first surface and a second surface opposite the first surface; and

directing a focused beam of laser pulses into the substrate at a location through the first surface of the substrate and, subsequently, through the second surface of the substrate,

wherein the focused beam of laser pulses has a wavelength to which the substrate is at least substantially transparent and wherein a beam waist of the focused beam of laser pulses is located within the substrate closer to the second surface of the substrate than to the first surface of the substrate, and

wherein the focused beam of laser pulses is characterized by a pulse repetition rate, a peak optical intensity at the substrate and an average power at the substrate sufficient to:

melt a region of the substrate near the second surface, thereby creating a melt zone within the substrate;

propagate the melt zone toward the first surface; and

vaporize or boil material of the substrate ~~and~~ located within the melt zone.