What is claimed is:

1. A method of performing laser spike annealing of a surface of a wafer, comprising:

generating with a plurality of fiber laser systems respective continuous-wave (CW) output radiation beams that form elongate images that partially overlap end-to-end at the surface of the wafer to form an elongate annealing image having a long axis and a length L_A along the long axis, wherein each elongate image has a Gaussian intensity profile with a length L as measured along the long axis and defined by a $1/e^2$ intensity contour, and wherein the partial overlap between adjacent elongate images is defined by a center-to-center offset $\Delta \leq 0.79 \cdot (L/2)$;

heating at least a region of the wafer to a pre-anneal temperature T_{PA} to define a pre-heat region; and

scanning the elongate annealing image over the surface of the wafer and at least partially within the pre-heat region in a direction substantially perpendicular to the long axis so that the elongate annealing image has a dwell time t_D in the range $30\ ns \leq t_D \leq 10\ ms$ and raises the temperature of surface of the wafer to an annealing temperature T_A.

2. The method according to claim 1, wherein the length L_A is in the range $3\ mm \leq L_A \leq 450\ mm$.

3. The method according to claim 1, wherein the elongate annealing image has width W_A measured perpendicular to the long axis, and wherein $25\ microns \leq W_A \leq 500\ microns$.

4. The method according to claim 1, wherein the CW output radiation beam has an amount of optical power PA in the range $100\ W \leq P_A \leq 10{,}000\ W$.

5. The method according to claim 1, wherein the pre-anneal temperature T_{PA} is in the range $200\ °C \leq T_{PA} \leq 600°C$.

6. The method of claim 5, wherein the anneal temperature T_A is either in the range 1,100 °C ≤ T_A ≤ 1,350 °C or in the range T_A ≥ 1,410 °C.

7. The method according to claim 1 further comprising:

measuring a temperature distribution at the surface of the wafer; and

adjusting an amount of power in at least one of the CW output radiation beams to improve an amount of uniformity in the temperature distribution.

8. The method according to claim 1, wherein the wafer has an edge, the elongate annealing image has an ~~end~~ end-most elongate image, and further comprising either reducing an amount of power in or turning off the CW output radiation beam that forms the ~~end of the~~ end-most elongate annealing image prior to the end-most elongate ~~annealing~~ image of the annealing image passing over the edge of the wafer.

9. The method according to claim 1, wherein the elongate images of the elongate annealing image ~~is~~ are formed by between three and fifty CW output radiation beams.

~~10. The method according to claim 1, wherein the CW output radiation beams define elongate images of length L that partially overlap along the long axis by an amount Δ, and wherein the amount of overlap Δ ≥ 0.79·(L/2).~~

~~11.~~10. A method of optimizing an amount of uniformity of an annealing image using a measurement wafer having a surface, comprising:

generating with a plurality of fiber laser systems respective continuous-wave (CW) output radiation beams that form respective elongate images that partially overlap end-to-end at the surface of the measurement wafer to form an elongate annealing image having a long axis and a length L_A along the long axis, wherein each elongate image has a Gaussian intensity profile with a length L as measured along the long axis and defined by a $1/e^2$ intensity contour, and wherein the partial overlap

between adjacent elongate images is defined by a center-to-center offset $\Delta \leq 0.79 \cdot (L/2)$;

detecting an amount of optical power reflected from the measurement wafer for each of the CW output radiation beams; and

adjusting an amount of optical power in one or more of the CW output radiation beams to optimize an amount of uniformity of the elongate annealing image.

~~12.~~11. A method of performing laser spike annealing of a surface of a wafer, comprising:

generating with a plurality of fiber laser systems respective continuous-wave (CW) output radiation beams that form respective elongate beams that partially overlap end-to-end at the surface of the wafer to form an elongate pre-annealing image having a long axis and a length L_A along the long axis, each elongate image has a Gaussian intensity profile with a length L as measured along the long axis and defined by a $1/e^2$ intensity contour, and wherein the partial overlap between adjacent elongate images is defined by a center-to-center offset $\Delta \leq 0.79 \cdot (L/2)$;

heating at least a region of the wafer with the elongate pre-annealing image to a pre-anneal temperature T_{PA} to define a pre-heat region; and

scanning a second laser beam that resides at least partially within the pre-heat region to raise the temperature of surface of the wafer to an annealing temperature T_A.

~~13.~~12. The method according to claim ~~12~~ 11, wherein the annealing temperature T_A is in the range 1,100 °C $\leq T_A \leq$ 1,350 °C.

~~14.~~13. The method according to claim ~~12~~ 11, wherein the annealing temperature T_A is greater than the melt temperature of doped silicon.

~~15.~~14. A system for performing laser spike annealing of a wafer having a surface, comprising:

a plurality of fiber laser systems that deliver respective output radiation

beams that form respective images that partially overlap end-to-end at the surface of the wafer to form an annealing image, wherein each elongate image has a Gaussian intensity profile with a length L as measured along the long axis and defined by a $1/e^2$ intensity contour, and wherein the partial overlap between adjacent elongate images is defined by a center-to-center offset $\Delta \leq 0.79 \cdot (L/2)$;

a wafer support assembly that supports the wafer and heats the wafer to a pre-anneal temperature T_{PA} and that moves the wafer relative to the annealing image so that the annealing image scans over the surface of the wafer with a dwell time of t_D in the range 30 ns $\leq t_D \leq$ 10 ms; and

wherein the annealing image has an amount of optical power P_A in the range 10 W $\leq P_A \leq$ 1,000 W so that the temperature of surface of the wafer is raised from a pre-anneal temperature T_{PA} to an annealing temperature T_A during said scanning.

~~16.~~15. The system according to claim ~~15~~ 14, wherein the pre-anneal temperature T_{PA} is in the range 200 °C $\leq T_{PA} \leq$ 600°C.

~~17.~~16. The system according to claim ~~15~~ 14, wherein the annealing temperature T_A is either in the range 1,100 °C $\leq T_A \leq$ 1,350 °C or in the range $T_A \geq$ 1,410 °C.

~~18.~~17. A system for performing laser spike annealing of a wafer having a surface, comprising:

a plurality of fiber laser systems that deliver respective output radiation beams that form respective elongate images that partially overlap end-to-end at the surface of the wafer to form an annealing image, wherein each elongate image has a Gaussian intensity profile with a length L as measured along the long axis and defined by a $1/e^2$ intensity contour, and wherein the partial overlap between adjacent elongate images is defined by a center-to-center offset $\Delta \leq 0.79 \cdot (L/2)$;

a pre-heat laser system that generates a pre-heat radiation beam that pre-heats a region of the surface of the wafer to a pre-anneal temperature T_{PA};

a wafer support assembly that supports the wafer and that moves the wafer relative to the annealing image so that the annealing image scans over the surface of

the wafer and at least partially within the pre-heat region with a dwell time of t_D in the range 30 ns ≤ t_D ≤ 10 ms; and

wherein the annealing image has an amount of optical power P_A in the range 100 W ≤ P_A ≤ 10,000 W so that the temperature of surface of the wafer is raised from the pre-anneal temperature T_{PA} to an annealing temperature T_A during said scanning.

~~19.~~18. The system according to claim ~~18~~ 17, wherein the pre-anneal temperature T_{PA} is in the range 200 °C ≤ T_{PA}≤ 600°C.

~~20.~~19. The system according to claim ~~18~~ 17, wherein the annealing temperature T_A is either in the range 1,100 °C ≤ T_A ≤ 1,350 °C or in the range T_A ≥ 1,410 °C.

~~21.~~20. A system for performing laser spike annealing of a wafer having a surface, comprising:

a plurality of fiber laser systems that deliver respective output radiation beams that form elongate images that partially overlap end-to-end at the surface of the wafer to form a pre-annealing image that pre-heats a pre-heat region of the surface of the wafer to a pre-anneal temperature T_{PA}, wherein each elongate image has a Gaussian intensity profile with a length L as measured along the long axis and defined by a $1/e^2$ intensity contour, and wherein the partial overlap between adjacent elongate images is defined by a center-to-center offset Δ ≤ 0.79·(L/2);

an annealing laser system that generates an annealing laser beam that at least partially overlaps the pre-heat region;

a wafer support assembly that supports the wafer and that moves the wafer relative to the pre-annealing image so that the pre-annealing image scans over the surface of the wafer and at least partially within the pre-heat region with a dwell time of t_D in the range 30 ns ≤ t_D ≤ 10 ms; and

wherein the pre-annealing image has an amount of optical power P_A in the range 100 W ≤ P_A ≤ 10,000 W so that the temperature of surface of the wafer is

raised from the pre-anneal temperature T_{PA} to an annealing temperature T_A during said scanning.

~~22.~~21. The system according to claim ~~21~~ 20, wherein the pre-anneal temperature T_{PA} is in the range 200 °C ≤ T_{PA}≤ 600°C.

~~23.~~22. The system according to claim ~~21~~ 20, wherein the annealing temperature T_A is either in the range 1,100 °C ≤ T_A ≤ 1,350 °C or in the range T_A ≥ 1,410 °C.