What is claimed is:

1. A method of annealing a semiconductor product wafer having a back side with an annealing region, the product wafer having electronic device features that reside a distance d from the back side and that are subject to being damaged beyond a critical temperature T_C, the method ~~comprising~~ consisting of:

scanning ~~an~~ a single annealing laser beam over the back side to anneal the annealing region by bringing the annealing region up to an anneal temperature T_A that is less than a melt temperature T_M of the semiconductor product wafer, wherein the annealing region is either an ion-implant layer or a contact layer; and

wherein the scanning of the single annealing laser beam defines the annealing region and has a thermal diffusion length L_D attendant therewith, and further including performing said scanning with a dwell time such that a thermal diffusion length L_D satisfies $L_D < d$ and wherein the electronic device features are maintained below the critical temperature T_C.

~~2. The method according to claim 1, wherein the annealing region is either an ion-implant layer or a contact layer.~~

~~3.~~2. The method according to claim 1, wherein the dwell time is in the range from 3 microseconds to 200 microseconds.

~~4.~~3. The method according to claim 1, wherein the electronic device features include metal and wherein the critical temperature T_C is in the range from ~~about~~ 600°C to ~~about~~ 900°C.

~~5.~~4. The method according to claim 1, ~~further comprising forming~~ wherein the semiconductor product wafer is constituted by ~~interfacing~~ a device wafer interfaced with ~~and~~ a carrier wafer, wherein the device wafer includes the electronic device features that defines the distance d.

~~6.~~5. The method according to claim ~~1~~ 4, wherein the single annealing laser beam has a visible wavelength or an infrared wavelength with an optical absorption length less than the ~~thin wafer~~ thickness of the device wafer.

~~7.~~6. The method according to claim 1, wherein the electronic device features include a CMOS device layer.

~~8.~~7. The method according to claim 1, wherein the electronic device features include a semiconductor power-device layer.

~~9.~~8. The method according to claim 1, ~~further comprising~~ wherein said scanning includes performing multiple scans of the single annealing laser beam over a same portion of the back side, wherein temporally adjacent scans are separated in time by a time interval τ, and wherein 1 millisecond $\leq \tau \leq$ 10 seconds.

~~10.~~9. The method according to claim ~~9~~ 8, wherein the number of multiple scans is 10 or fewer.

~~11.~~10. The method according to claim 1, wherein 5 μm $\leq d \leq$ 150 μm.

~~12.~~11. The method according to claim 1, wherein 10 μm $\leq d \leq$ 20 μm, the electrical device features are made of aluminum, and wherein the dwell time t_d is between ~~about~~ 3 microseconds to ~~about~~ 20 microseconds.

~~13.~~12. The method according to claim 1, wherein 10 μm $\leq d \leq$ 20 μm, the electrical device features are made of copper, and wherein the dwell time t_d is between ~~about~~ 15 microseconds to ~~about~~ 100 microseconds.

~~14.~~13. A method of annealing a product wafer, comprising:

forming a product wafer by forming a protective structure over a front side

of a device wafer having a back side and a thickness d between 5 microns and 150 microns, wherein the front side includes electronic device features that are subject to being damaged if heated beyond a critical temperature T_C;

forming an annealing region in or on the back side of the device wafer, wherein the annealing region includes an ion-implanted doped layer formed within the back side or a contact layer formed on the back side; and

scanning ~~an~~ a single annealing laser beam over the back side to perform non-melt annealing of the annealing region, wherein the scanning is performed with a dwell time that defines a thermal diffusion length $L_D < d$ and wherein the electronic device features are maintained at a temperature below the critical temperature T_C.

~~15. The method according to claim 14, wherein the annealing region is either an ion-implanted doped layer formed within the back side or a contact layer formed on the back side.~~

~~16.~~14. The method according to claim ~~14~~ 13, further comprising performing multiple scans of a same portion of the back side with the single annealing laser beam, wherein temporally adjacent scans are separated by a time interval τ, and wherein 1 millisecond $\leq \tau \leq$ 10 seconds.

~~17.~~15. The method according to claim ~~16~~ 14, wherein the number of multiple scans is 10 or fewer.

~~18.~~16. The method according to claim ~~14~~ 13, wherein the protective structure includes a carrier wafer.

~~19.~~17. The method according to claim ~~14~~ 13, wherein the protective structure consists of a single protective layer.

~~20.~~18. The method according to claim ~~14~~ 13, wherein the electronic device

features include at least one of a metal and a CMOS layer.

~~21.~~19. The method according to claim ~~14~~ 13, wherein the electronic device features include a semiconductor power-device layer.

~~22.~~20. The method according to claim ~~14~~ 13, wherein the dwell time is in the range from 3 microseconds to 200 microseconds.

~~23.~~21. The method according to claim ~~14~~ 13, including selecting the dwell time to be less than a maximum dwell time t_{dm} defined by $t_{dm} = d^2/D_{eff}$, where D_{eff} is the effective thermal diffusivity of the device wafer.

~~24.~~22. The method according to claim ~~14~~ 13, wherein the annealing laser beam has a visible wavelength or an infrared wavelength with an optical absorption length less than the thin-wafer thickness.

~~25.~~23. The method according to claim ~~14~~ 13, wherein 10 μm ≤ d ≤ 20 μm, the electrical device features are made of aluminum, and wherein the dwell time t_d is between ~~about~~ 3 microseconds to ~~about~~ 20 microseconds.

~~26.~~24. The method according to claim ~~14~~ 13, wherein 10 μm ≤ d ≤ 20 μm, the electrical device features are made of copper, and wherein the dwell time t_d is between ~~about~~ 15 microseconds to ~~about~~ 100 microseconds.