

ULTRA SHORT TIME ANNEALING

Micro- / Millisecond Annealing with Flash Lamps or Laser Modules

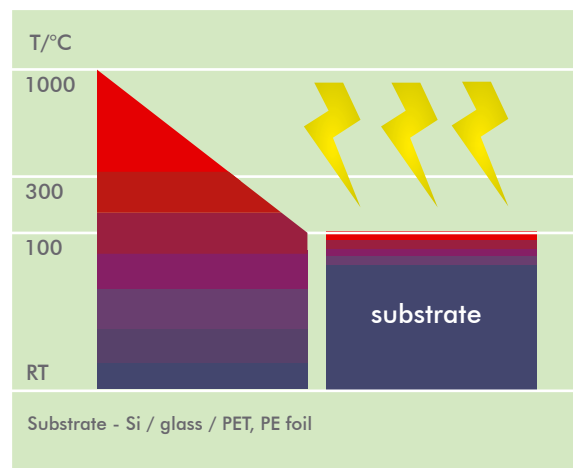
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Novel thin-film technologies (e.g. spraying, printing) on innovative substrates (e.g. PET, polymer foils, paper) require new annealing technologies for surface modification.

Electric, optical and mechanical properties of such layers deposited at low temperatures need to be improved by annealing steps, e.g. for crystallization, drying or simply to evaporate solvents.

The annealing of such layers is a great challenge in the case of heat sensitive substrates. Conventional annealing methods like oven or RTP anneal may cause irreversible damage, since the whole substrate is heated.

Therefore, novel annealing techniques in the millisecond or microsecond range are of great interest, since they allow heat management for thin layers at the surface.



> Temperature profile of a flashed substrate

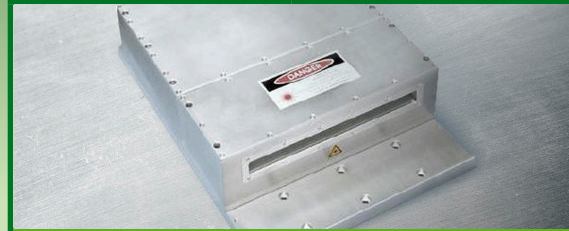
Advantages of short time annealing:

- high ramp-up rates ($>> 10.000 \text{ K / s}$)
- backside remains cold
- reduced thermal budget



FLASH LAMP SYSTEM PARAMETERS

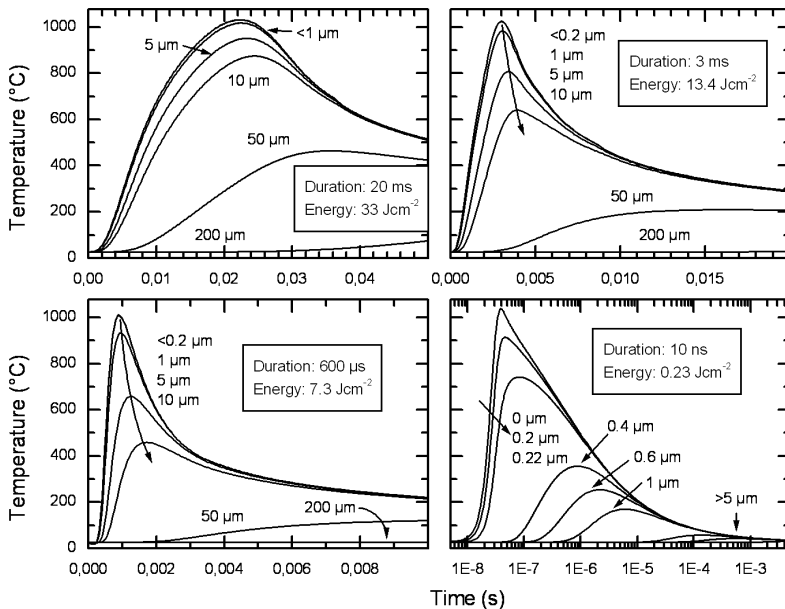
temperatures	up to 2000°C
power (max.)	12 MW
energy density	up to 120 Jcm ⁻²
wafer size	2", 3", 4"
pulse duration	20, 10, 3, 1 or 0.6 ms (others upon request)
atmosphere	vacuum, Argon, Nitrogen, reactive gases
Preheating stage with halogen lamps	up to 1100°C
Preheating stage with hotplate	up to 500°C



LASER SYSTEM PARAMETERS

Wavelength	808 nm +/- 10 nm (others upon request)
FWHM	< 8 nm
Power	> 1000 W
Line length	100 mm (at typical working distance) optional: 156 mm (at 1500 W power)
Beam width	2.3 +/- 0.3 mm (at typical working distance)
Homogeneity	+/- 5% (over 80 mm line length) (optional: improved homogeneity)
Working distance	290 +/- 20 mm
Operation	cw or pulsed mode
Lifetime	10.000 h (according to ISO 17526:2003)
Preheating stage with hotplate	up to 500°C

DTF laser tools are developed in collaboration with LIMO Mikrooptik GmbH.



Temperature profiles vs. depths for different annealing durations (layer system: 200 nm ITO on 200 μm PET foil).

Pulse durations in the ms or sub-ms range cause heating of the very first μm of the substrate only, while the deeper regions remain at lower temperatures.