

# **Laser Induced Thermal Stresses In Solids: Exponentially Time Decaying Pulse Case**

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## **Summary**

Laser heating of solid substrates results in thermal expansion of the region irradiated by a laser beam. Depending on the intensity and duration of the laser pulse, the thermal stress levels developed in this region vary. In the present study, laser heating of solid substrate is considered and analytical solutions for temperature and stress fields inside the substrate material are presented. In the analysis, time exponentially decaying pulse is considered and Laplace Transformation method is used to obtain the closed form solutions. It is found that temperature rises rapidly in the early heating period due to domination of internal energy gain over the diffusional energy loss from the surface vicinity to the solid bulk. Thermal stress wave generated propagates towards the solid bulk and stress level behind the stress wave is tensile while it is compressive after the wave.

## **References:**

1. ALADAWI MK, 1995, INT J HEAT MASS TRAN, V38, P947
2. ARIF AFM, 2001, P I MECH ENG C-J MEC, V215, P291
3. DANISMAN K, 1991, P SPIE GAS METAL VAP, V1412
4. ELPERIN T, 1996, INT COMMUN HEAT MASS, V23, P133
5. KALYON M, 2001, P I MECH ENG C
6. LI K, 1995, INT J MACH TOOL MANU, V35, P1493
7. MODEST MF, 1998, J HEAT TRANS-T ASME, V120, P892
8. SIMON G, 1993, J PHYS D APPL PHYS, V26, P862
9. WANG HG, 1997, J MATER PROCESS TECH, V63, P550
10. YILBAS BS, 1995, INT J MACH TOOL MANU, V35, P1047
11. YILBAS BS, 1997, APPL SURF SCI, V108, P167

12. YILBAS BS, 1997, INT J MECH SCI, V39, P671
13. YILBAS BS, 1998, OPT LASER ENG, V30, P25
14. YILBAS BS, 2001, J PHYS D APPL PHYS, V34, P222

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