

Theoretical Study of Laser-Ultrasonic Generation

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Abstract

We discuss the theories in the generation and detection of laser-ultrasonics and present the results obtained from the numerical calculations based on the theories. We carry out the computation of the spatial and temporal distributions of the temperature inside the material. Calculating the displacement of the surface at the epicenter, we make discussions on the characteristics of the ultrasonic wave propagation in the thermoelastic and ablation regions.

Figures

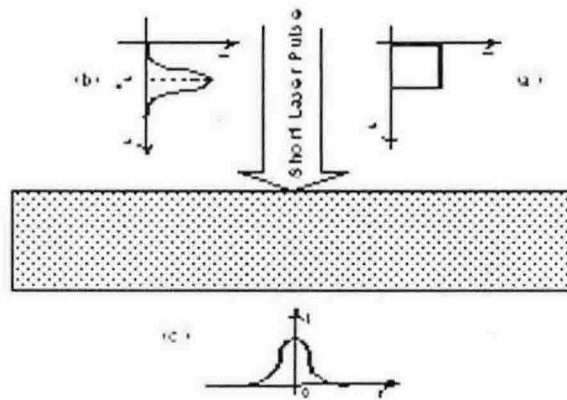


Figure 1. A schematic of laser-ultrasonic generation with laser beam profiles; (a) step function in time, (b) Gaussian in time, (c) Gaussian in beam radius.

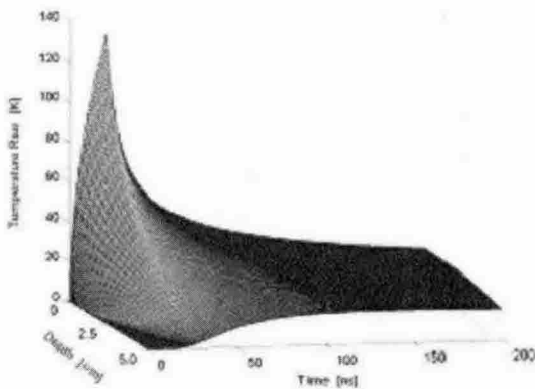


Figure 2. Evolution of temperature distribution along the depth for the case of Fig. 1 (a).

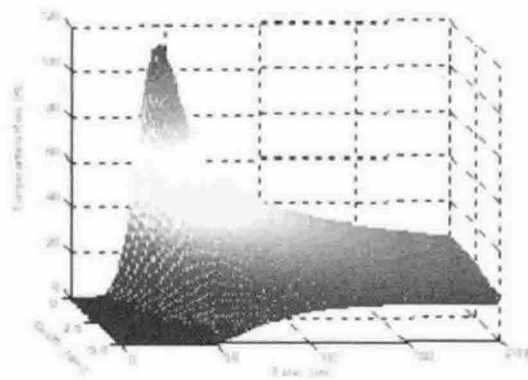


Figure 3. Evolution of temperature distribution along the depth for the case of Fig. 1 (b).

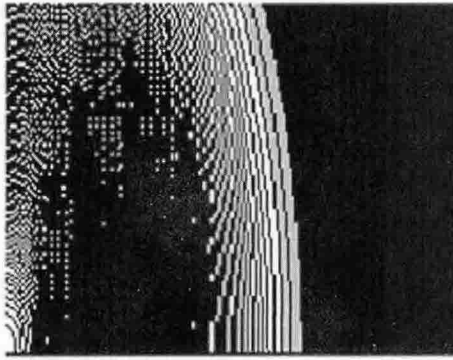


Figure 4. Temperature distribution in the r - s plane for the case of Fig. 1 (b) and (c) at $t=20$ ns.

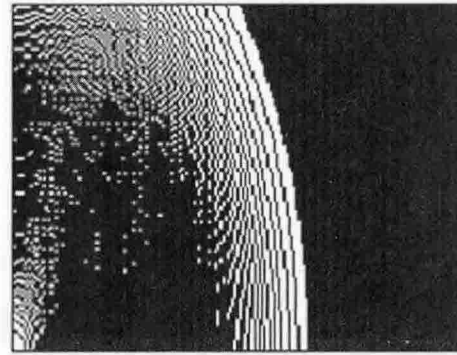


Figure 5. Temperature distribution in the r - s plane for the case of Fig. 1 (b) and (c) at $t=40$ ns.

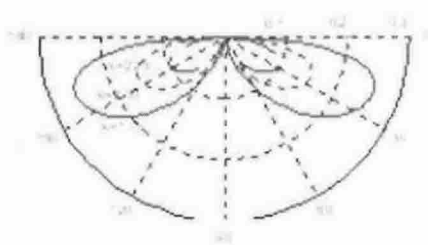


Figure 6. Directivity of the compressional wave generated in the thermoelastic region.

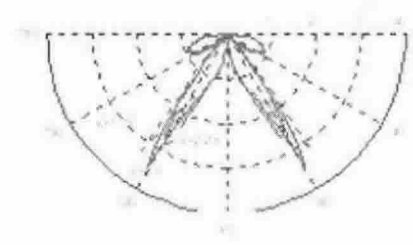


Figure 7. Directivity of the shear wave generated in the thermoelastic region.

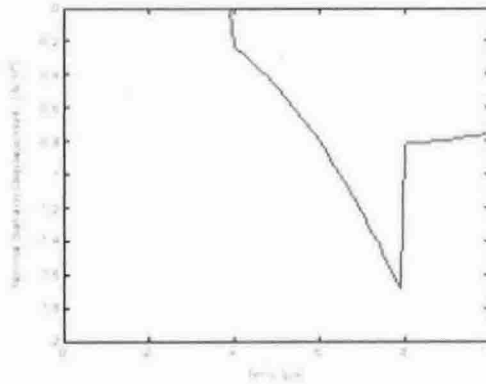


Figure 8. Thermoelastic waveform generated by a step impulse at the epicenter, by a step

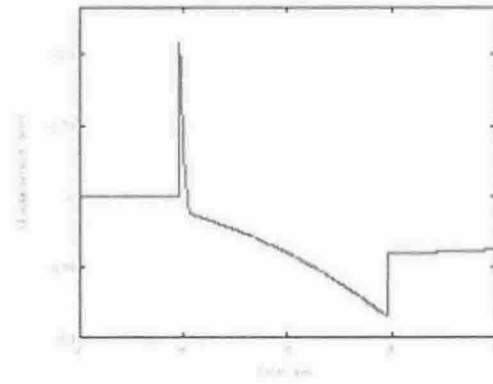


Figure 9. Thermoelastic waveform generated Impulse with a delta-type impact at the epicenter.