Quantitative Lock-in Thermography Imaging of Thermal Diffusivity of Non-Flat Solid Structures

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Lock-in thermography (LIT) imaging characterization for solid materials of non-flat structures will be presented. Particularly, we established a theoretical photothermal model and its experimental validation for an infinitely long solid with an inner corner of arbitrary opening angle, with the solid being irradiated photothermally by a modulated laser beam of arbitrary spatial intensity distribution directed to the corner. The thermal-wave field distribution on the flat surfaces of the solid centered at the corner was obtained using the Green function method. Experimental results based on quantitative LIT imaging were obtained and used to validate the theoretical model in which the thermal diffusivity of a stainless steel sample with an inner corner was measured and the thermal-wave field spatial distribution in the neighborhood of the inner corner was explored. The thermal-wave theory-based LIT imaging technique provides a fast quantitative tool for thermal property measurements and/ or non-destructive evaluation of non-flat structures in industrial applications. It also generates valuable physical insights into the spatial distribution of the thermal-wave field in the neighborhood of geometric discontinuities such as inner corners in solids.

References

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