Quantitative Thermophysical Property Imaging in Multi-Layered Industrial Solids Using Frequency-Domain (Lock-In) Thermography and the Thermal-Wave Radar: Multi-Parameter Measurement Reliability and Precision Studies

Andreas Mandelis [C, S], Jordan Tolev, Konesh Sivagurunathan and Zichun Tang
Center for Advanced Diffusion-Wave Technologies (CADIFT), Mechanical and Industrial Engineering, University of Toronto, Toronto, Ontario, Canada
mandelis@mie.utoronto.ca

A non-destructive quantitative lock-in thermography imaging technique using a mid-infrared camera for evaluation of the absolute values of thicknesses and thermophysical parameters of industrial coated samples from images obtained in a sequence of laser beam modulation frequencies has been developed. Analytical studies of associated photothermal radiometry frequency scans were undertaken to measure the values of several geometrical and thermophysical parameters of a metal substrate with a deposited thin coating layer. The quantitative multi-parameter results were studied with regard to measurement reliability (uniqueness) and precision using two independent best-fit programs. The lock-in thermography technique was further extended to thermal-wave radar imaging, a modality found to exhibit better contrast and much faster image acquisition rate, very desirable attributes for industrial inspection and manufacturing quality control.