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Quantitative infrared thermography applied to blow moulding process: measurement of a heat transfer coefficient

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Abstract

This paper deals with the heat conditioning stage of blow moulding process applied to P.E.T bottles forming. One of the most important stage of this process is the radiative heating stage which is performed with infrared ovens using powerful halogen lamps. To validate a 3D control volume thermal software, called Plastirad, developed in our laboratory, temperatures maps were needed on the plastic preforms as well as convective heat transfer coefficient inside the oven. This measurement has been performed with two different methods : IR thermography and hot wire anemometry. These two methods are investigated and the main results are compared to focus on the interest of IR thermography.

Keywords

blow moulding, IR camera, semi-transparent material, convection coefficient, anemometry

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Lock-in IR thermography for functional testing of solar cells and electronic devices

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Abstract

Lock-in thermography (LIT), which is a standard tool in nondestructive testing (NDT), is also very advantageous for electronic device testing (EDT). In this contribution the special points of view of LIT applied in EDT are reviewed. In EDT it may be useful to display not only the amplitude or the phase image but also images of the magnitude of special phase components. The "0°/-90°" image as a new kind of representation is especially advantageous to display microscopic lock-in thermograms of integrated circuits (ICs). Just as the phase image, the 0°/-90° image is inherently emissivity-corrected, but it provides a considerably better spatial resolution. The quantitative interpretation of EDT thermograms in terms of a lateral power distribution is reviewed with special emphasis to the measurement of local power sources and the numerical inversion of lock-in thermograms enabling a higher spatial resolution. Experimental details of a lock-in thermography system specialized to electronic device testing are introduced with a number of representative application examples demonstrating the universal applicability of this technique in EDT.

Keywords

Lock-in thermography, electronic devices, functional testing, IR microscopy, local heat sources.

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Detecting water in aviation honeycomb structures: the quantitative approach

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Abstract

Infrared thermographic inspection of water in aviation honeycomb panels is a well-known technique. The hidden water can be detected due to its high thermal capacity that makes temperatures changes slow. A transient thermal regime can be realized by using external heaters or natural heating by the ambient. The paper describes some quantitative aspects of the water detection problem. The presented simulation results have been obtained by analyzing a one-dimensional model of a multi-layer plate where the ice-to-water phase transformation takes place. Some experimental results of inspecting Russian airplanes are also presented..

Keywords

Stimulated infrared thermography, Non Destructive Evaluation, honeycomb structures, liquid ingress detection

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Monitoring acupressure stimulation effects by infrared thermography

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Abstract

Acupressure is a healing therapy that provides stimulation without needle by applying any pressure to the meridians of traditional Chinese acupuncture (the most important branch of the tTraditional Chinese medicine). This article presents an application of the infrared thermography to the thermal reactivity of Human body skin due to the acupressure stimulation. To survey an in vivo human skin surface, during the feasibility and material validity test, we will discuss the different sources of uncertainties and slants bound to the measurement by infrared thermography, such as the skin surface's emissivity, the noise and the drift of the camera as well as the influence of the radiance emitted by the ambient surroundings. The main aim of this work is to highlight in infrared an objective evidence of the acupuncture points by infrared thermography under acupressure stimulation defined by the traditional Chinese acupuncture, by refining infrared thermography measuring methods. And finally twelve healthy acupuncture-naïve volunteers of our University participated to this scientific experimentation: a single-blinded in vivo trial "formula, placebo and sham" session.

Keywords

Infrared Thermography, Acupressure, Traditional Chinese Acupuncture Meridian, Human Skin Emissivity, Contrast Image

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Heat flux characterisation in hot jet and flame/wall interaction by IHCP resolution coupled with infrared measurements

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Abstract

The aim of this work is to develop a method dedicated to the identification of heat fluxes between turbulent flames and 3D solids in order to improve the conception of aeronautic structures designed to endure and sustain fire events. Transient temperature modelling inside the impinged structure can only be realistic if the convective

and radiative heat fluxes used as boundary conditions of the numerical model are accurately known. To do so, these two different heat transfer contributions are to be separated from the total heat flux information, obtained by solving an IHCP (Inverse Heat Conduction Problem). The inverse technique that was implemented for this study is based on adding back-face infrared measurements data as observation equation, thus closing this ill-posed problem. Infrared camera provides an accurate temperature map, allowing high resolution heat flux mapping without perturbing the impingement zone. The number of unknowns initially equal to the camera resolution is reduced by solving the problem in the cosine space thanks to Discrete Cosine Transform. As for the resolution of this multidimensional transient IHCP, Beck's inverse algorithm has been coupled to future time-steps stabilisation method. Flame to wall heat transfer knowledge is improved thanks to the study of a dedicated test bench composed of a propane / air burner on the one hand, and a 14kW air heater on the other hand. To take into account the spatial non-uniformity of the adiabatic wall temperature used in Nusselt calculation, a new adiabatic wall temperature computation is presented and compared to Nusselt calculations based on constant reference temperature. In the scope of this study, we present the comparison between propane/air flame and hot round isothermal air jet impinging perpendicularly on a titanium plate.

Keywords

IHCP, Round isothermal jet, Flame impingement, DCT, Infrared

QIRT Journal, 1, 2, pp.229-240

Focal plane array infrared cameras as research tools

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Abstract

Temporal, thermal and spatial performances of some FPA cameras have been tested. Different disturbing behaviors related to this recent technology have been pointed out, especially with a view to research and development applications.

Keywords

infrared cameras, FPA systems, spatial resolution, thermal resolution, calibration

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Local thermal diffusivity measurement

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Abstract

In plane thermal diffusivity is measured using a one-side thermographic technique suitable for on field use. Applying an uneven heating on the sample surface and measuring the time evolution of the Fourier Transform of the temperature leads to a simple identification formula. The technique has been applied on both thermally thin and thick samples. Results achieved for porous materials (construction stones) and stainless steel have been compared with those obtained by the classical two-side flash method.

Keywords

Thermal diffusivity, Infrared thermography
