

Experimental Determination of the Directional Emissivity of Materials Using a Periodic Thermal Excitation Coupled with Infrared Thermography

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Variation of directional emissivity upon emission angle can be deduced theoretically from the complex refraction index. Nevertheless, theoretical relations are only valid for perfectly smooth surfaces and homogeneous materials. Directional emissivity is generally nearly constant for emission angles lower than 60 degrees from the normal incidence, but strong variations are expected for angles higher than 60 degrees either for dielectric materials or for conducting ones. Many experimental devices were developed to determine directional emissivity of materials. Generally, these devices are quite complex and fail in measuring directional emissivity for angles greater than 80 degrees. Thus, it is still difficult to point out deviations between theoretical and experimental values for high emission angles. Current work concerns the development of a device (SPIDER Instrument) allowing to determine directional emissivity of dielectric or conducting materials. The rear face of the sample is heated periodically. Temperature variations are recorded using a thermocouple. Sample surface temperature variations are recorded using an infrared camera. By comparing at several frequencies and emission angles, the temperature amplitudes recorded, it is possible to determine relative variations of directional emissivity. If directional emissivity is known at a given emission angle, then directional emissivity can be calculated at any emission angle.