Measurement of Emissivity and Infrared Optical Properties at PTB

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The Physikalisch-Technische Bundesanstalt (PTB) operates in its department "Detector Radiometry and Radiation Thermometry" several facilities which allow the accurate measurement of the directional spectral emissivity, reflectivity and transmissivity. These facilities allow measurements of emissivity in air and under vacuum from 1.2 µm to 100 µm in a temperature range from -40 °C to 1000 °C and up to 2000 °C at 1064 nm. Reflectivity and transmissivity could be measured at room temperature up to wavelengths of 1000 µm. The accurate knowledge of the emissivity, reflectivity and transmissivity of a material is crucial for a variety of technological applications whenever heat transfer by radiation becomes significant or temperature is monitored via radiation thermometry. Recent examples of applications which require very low uncertainties of emissivity are absorbers for solar thermal electricity generation and coatings of onboard reference blackbodies for benchmark missions in space. Here we give a short overview of the capabilities for non-contact temperature measurement in the department. In more detail we present the facilities used for optical property measurements and give examples for recent results. The emissivity measurement setup under vacuum is part of the Reduced Background Calibration Facility (RBCF) at PTB where all critical components of the optical path are under vacuum and cooled with liquid nitrogen. Hereby the infrared background radiation is largely reduced. The facility under air is precisely temperature stabilized to provide a constant background. The scheme for direct emissivity measurements at both facilities is based on the measurement of the spectral radiance of a sample inside a temperature stabilized spherical enclosure with respect to the spectral radiance of two reference blackbodies at different temperatures whereby the remaining background is cancelled. Directional spectral emissivities above 1000 °C are measured with a dynamic method based on a modified laser flash apparatus for thermal diffusivity measurement.