

Optimized Apparatus for Measuring the Angular Dependent Surface Emittance at Elevated Temperatures up to 1400°C

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In general, the emittance of a certain material is given by the ratio of the radiation intensity emitted by a surface and the intensity emitted by a blackbody at the same temperature, wavelength and angle. The exact knowledge of the spectral surface emittance is vitally important for many physical and technical applications, especially when the radiative heat transport needs to be specified or when contactless temperature measurements have to be performed. Theoretical modeling of the emittance cannot be easily accomplished. This is due to the fact that the spectral emittance strongly depends on the surface conditions, such as the degree of oxidation and the roughness. Therefore, the experimentally determined emittance values for a material to be found in the technical literature are imprecise, often differing considerably from each other, and are only rarely available at high temperatures. Moreover, angle- and wavelength-dependent emittance values can only be detected by a direct radiometric method. Thus, an optimized apparatus for measuring the angular dependent surface emittance up to elevated temperatures has been designed. The central part of the apparatus is a double walled, liquid cooled vacuum chamber with a cylindrical tube furnace which is pivot-mounted for automatic rotation up to an angle of 180°. This allows both the measurement at different detection angles (0° to 85°) and a consecutive measurement of the sample and a blackbody reference. Additionally, the measurements can be performed at different gas pressures, or respectively in different gaseous atmospheres. The aim of this work is to present the emittance measurement apparatus (EMMA) which enables the determination of the spectral emittance of opaque samples in the wavelength range between 2 and 18 microns and at temperatures up to 1400°C. Along with the setup of the apparatus, different measurement results are presented and compared to literature values.