Advancement and First Results of the Emissivity Measurement Facility Under Vacuum at PTB for Sample Temperatures Up to 1000 °C

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The facility for emissivity measurement under vacuum at the Physikalisch-Technische Bundesanstalt (PTB) allows measuring the directional spectral emissivity in the wavelength range from 1.3 µm to 100 µm and in the temperature range from -40 °C to 450 °C. A further facility, the dynamic emissivity measurement facility at PTB, covers a temperature range from 800 °C to 2000 °C at a wavelength of 1064 nm. To bridge this gap in temperature and spectral range and to enable the direct comparison of both facilities we designed and optimized a sample holder dedicated to angle-resolved emissivity measurements up to 1000 °C.

Here we present the design and characterization of the new sample holder. Essential for achieving a low uncertainty in emissivity measurement is to attain a homogeneous temperature distribution on the observed sample surface. The design of the sample holder, i.e. its heating concept and the thermal quantities of the applied materials, determine the quality of the attained temperature homogeneity. Furthermore, the sample itself, i.e. its surface emissivity and thermal conductivity, affects this temperature uniformity. We evolved a heating concept which is able to reach these high temperatures with a moderate power input of around 500 W, which can be easily provided by commercial heated filaments, and which allows optimization of the surface temperature uniformity for a large range of sample properties. We discuss the resulting final sample holder concept and the issues of getting a homogeneous temperature distribution on the sample surface even at very high temperatures up to 1000 °C. Temperature uniformities of the sample holder measured at several temperatures with an IR camera system carefully corrected for its own non-uniformity will be shown. Finally, high temperature spectral directional emissivity measurements of tungsten obtained with the new sample holder will be shown.