New System for Spectral Emissivity Measurements at the University of Duisburg

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The Heat Radiation Laboratory at the University of Duisburg over some years conducts measurements of the spectral emissivity of vast variety of metals, ceramics and refractories over a wide range of temperatures. Previously, spectral radiation measurements were made with a prism monochromator with interchangeable detectors connected to a lock-in amplifier. This system is mounted on tracks and is placed in front of the various radiation sources. The system has several blackbody emitters for referencing, a water-cooled bell furnace with resistant heating of metal samples in a protective gas atmospheres and two furnaces for heating ceramic samples in air.

Measurements can be conducted across a temperature range from 200°C to 1200°C for ceramics and from 200°C to 1600°C for metals. The limits are set in part by the design of the furnaces and the sensitivity of the instrumentation. The measurable spectral band is from 0.8 to 16 µm.

A new Fourier Transformation Infrared (FTIR) spectrometer (Bruker, Type EQ55s), with rapid scan mode, has been placed parallel to the prism monochromator and been integrated into the measurement system. The spectrometer is fitted with an optic module allowing for precise focusing on the sample's surface.

The new measurement system has the following characteristics:
Spectral range with piezoelectric sensor: 1 to 25µm,
Spectral range with Si diode sensor: 0.4 to 1µm,
Measurement duration - ca. 1 minute with a resolution better as 0.2µm.

The majority of measurements are conducted on samples whose surface does not change. The rapid scan mode makes it possible to make dynamic measurements, for example on metal surfaces during oxidation. Furthermore the dramatically shorter measurement duration of 1 minute compared to the previous system's two hours is an advantage for temperature dependant measurements.

The newly integrated spectrometer is to be tested and a series of measurements conducted to establish the reliable measurement range for the different sensors at different temperatures. The reproducibility and the comparison of results with the previous instrumentation are also to be investigated. This should show that the new measurement system measures the spectral emissivities reliably as the proven prism spectrometer system.

The discussion will present and compare the two measurement systems for a chosen set of spectral emissivities of samples of refractories and steels.