Development, Simulation and Realization of a Nearly Lambertian Surface for the FIR Range

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Integrating spheres (IS) are optical instruments designed to measure directional-hemispherical reflectance and transmittance of different surfaces or windows. The uniform irradiance on the complete inner surface of the IS is a prerequisite to avoid measurement artefacts and to achieve results with lowest uncertainty. To achieve a uniform irradiance a Lambertian reflectance characteristic of the inner surface is required. However, currently existing surfaces do not show good Lambertian properties in the far infrared range (FIR) because they tend to become specular in this range. So, it is still a problem to measure directional-hemispherical reflectance and transmittance in the far infrared (FIR) range up to 100 µm with an IS.

Physikalisch-Technische Bundesanstalt (PTB) aims to develop a new integrating sphere suitable for reflectance and transmittance measurements in the FIR range up to 100 µm. By iterative computer modeling of the surface and subsequent simulation of the reflection characteristics by ray tracing several types of surfaces were investigated and some promising candidates were identified. Here we present the design approach and a structure of the surface, which should, according to simulations, have nearly Lambertian properties over the whole spectral range from 5 µm to 100 µm. We will also show the manufactured test samples and a comparison of experimentally measured angular resolved reflectance data with the performed simulations.