Capabilities for Normal Spectral Emittance Measurements at NIST: Present Status and Future Extension for Temperatures up to 1300 K

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Facilities for measuring the optical properties of solid materials at cryogenic and near-ambient temperatures, developed at NIST Optical Technology Division during the last decade, allow accurate determination of absolute transmittance and reflectance for both specular and diffuse materials. This, in turn, indirectly provides directional spectral absorptance and emittance data for both opaque and translucent samples. These facilities, described in detail in previous papers, are built around bench-top Fourier transform spectrometers combined with custom accessory instrumentation, and feature optimal metrological parameters, which are briefly outlined in the present report. At elevated temperatures (higher than 600 K) direct measurements of emittance, i.e. absolute measurements of radiant exitance of the sample surface, have several advantages compared with indirect methods. At the same time all methods, based on measurements of self-emitted radiation, share one principal difficulty caused by the need to accurately measure the actual temperature of the sample surface. To meet the existing demand for measurements of emittance of opaque and semi-transparent materials, a new facility is being built at NIST. While the most critical need is for emission measurements of semi-transparent materials, the present effort is focused on opaque samples. It is expected that as soon as the optical setup is built and opaque standard samples are characterized, the next stage to handle semi-transparent samples will follow. The approach we have selected for direct emittance characterization is to some extent similar to that employed in earlier facilities, sharing the FTIR detection technique and hemi-ellipsoid mirror based measurements of hemispherical-directional reflectance. The latter measurement is performed at only a single spectral point to allow a radiometric determination of the actual temperature of the surface of the sample. We will discuss the anticipated performance of the new facility, the optical setup and the principles of measurement, as well as further development prospects.