Comparison of spectral irradiance responsivity scales of TKK and NIST in the UVA region

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Abstract. This paper presents the results of a bilateral comparison of spectral irradiance responsivity scales of Helsinki University of Technology (TKK, Finland) and the National Institute of Standards and Technology (NIST, USA). The comparison was performed at UVA wavelengths by measuring the spectral irradiance responsivity of a broadband UVA detector at both laboratories. The results at the passband coincided within 1%, which is well within measurement uncertainties.

Introduction

Broadband UV detectors find use in several fields of science and technology. Calibration of such detectors is a complicated task, which requires fundamental understanding of the properties of the detector, as well as of those of the radiation source. The calibration of a broadband detector is always source dependent; it applies only to the source that was used in the calibration, or to other sources with similar spectral shape.[1] Measuring the spectral irradiance responsivity of the detector enables determination of its calibration factor for any radiation source whose spectral shape is known.[1,2]

Measurement setup at TKK

The measurement setup for the measurement of spectral irradiance responsivity at TKK consists of a 450-W xenon source (Xe900, Edinburgh Instruments Ltd) and a single grating monochromator (TMc300, Bentham Instruments Ltd). The use of an intense UV source, together with a single grating monochromator, ensures the output power to be sufficient for spectral measurements with detectors of low sensitivity. The use of a single grating monochromator, instead of a double grating monochromator, increases the level of stray light. However, studies made so far, including the comparison measurement described in this paper, indicate that the level of stray light is not significant in the UVA region. Further studies are being performed in order to characterize the effect of stray light in measurements at shorter wavelengths.

Comparison between TKK and NIST

In May 2003, TKK and NIST made a bilateral comparison of spectral irradiance responsivity scales. A broadband UVA detector, labeled FR1, was used in the comparison. The detector, property of NIST, had been measured at NIST before it was brought to TKK, where it was measured with the measurement setup described above. Figures 1 and 2 show the results.

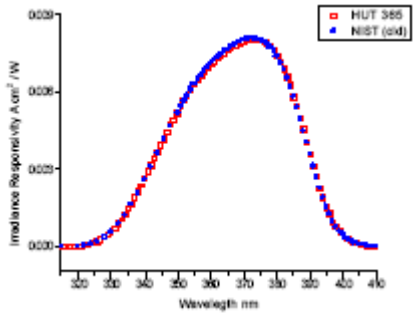

Figure 1. Measured spectral irradiance responsivity of FR1.

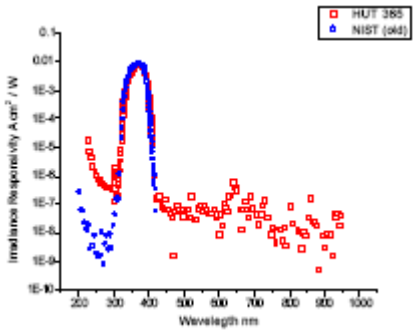

Figure 2. Measured spectral irradiance responsivity of FR1, shown on a logarithmic scale.

To compare the results between the two laboratories, integrated responses were calculated. These values differed less than 1%. The calculated effective wavelengths differed 0.04 nm.

Conclusions

The results of this comparison measurement show that the spectral irradiance responsivity scales of TKK and NIST are in agreement in the UVA region. The difference between the measured responsivities is well within measurement uncertainties, TKK uncertainty alone is 2% (k=2). The larger difference in measured responsivities at shorter wavelengths, clearly noticeable in Figure 2, is most likely due to stray light. The stray light properties of the TKK setup are to be carefully examined. The slit scattering function of the monochromator has been measured with six laser wavelengths. These data will be used in the future to estimate the magnitude of the stray light effect in the measurements, using the method described by Brown

et al.[3]

References

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