IRS2012-104
International Radiation Symposium 2012
Dahlem Cube, Berlin, Germany, 06 – 10 August 2012

Stability of light-emitting diodes in the solar UV spectral range

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Shortening the traceability chain and reducing the uncertainties of spectral solar UV radiation measurements in the wavelength range 290 nm to 400 nm is the goal of the European Metrology Research Project "Traceability for surface spectral solar ultraviolet radiation". One of the tasks in this project is the development of compact, stable, and portable monitoring sources based on state-of-the-art commercially available UV light-emitting diodes (LEDs). These sources will be used to maintain the spectral calibration of spectroradiometers while deployed at the solar UV measurement sites.

As a first step, commercially available UV-LEDs are characterized with respect to their stability. At the Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig, Germany, UV-LEDs with the following peak wavelengths have been chosen (3 LEDs of each type, manufacturer: SETi (Sensor Electronic Technology, Inc.), distributor: Roithner Lasertechnik): 285 nm, 300 nm, 315 nm, 330 nm, 335 nm, and 365 nm. Additionally, LEDs of different design with 370 nm and 405 nm peak wavelength have been bought (Roithner Lasertechnik). A fully automated measurement setup with two rotary stages, carrying detectors and emitters, respectively, is used to monitor the stability of the constant-current driven LEDs at the PTB. All LEDs are mounted in separate holders, each equipped with a thermostat. The temperature, the forward voltage, and the current of each UV-LED is monitored. Two monitor detectors have been built using a SiC photodiode (sglux SolGel Technologies) and a Si photodiode (Hamamatsu), respectively, which also are equipped with thermostats. In addition to the SiC and Si photodiodes, an array spectroradiometer is used to monitor the stability of the emitted spectra. At the Bundesamt für Metrologie (METAS) in Bern-Wabern, Switzerland, the stability of UV-LEDs with peak wavelengths of 290 nm, 315 nm, 335 nm and 355 nm (4 LEDs of each type, manufacturer: GMP) were chosen for the studies. The radiant flux of the UV-LEDs is measured by a temperature stabilized GaAsP trap detector. The temperature of the UV-LEDs is kept constant through a Peltier element. In addition, the forward voltage is monitored. Each UV-LED is measured over a period of at least 50 h.

In this paper we will analyze the temporal stability of UV-LEDs and evaluate their applicability in monitoring sources to maintain the calibration of solar UV spectroradiometers.