Material Emissivity Determination by Virtual Source Method in Temperature Applications

Peter Pavlasek [C, S], Milan Ioan Maniur and Peter Nemecek
Temperature group, Slovak Institute of Metrology (SMU), Bratislava, Slovakia, Slovakia
peterpavlasek@gmail.com

Stanislav Duris and Lukas Duris
Institute of automation, measurement and applied informatics, Slovak University of Technology, Bratislava, Slovakia, Slovakia

Precise and reliable methods for material properties determination have played an important role in many fields of science. Emissivity as one of the material properties is important for temperature metrology and more specific for the radiation thermometry measurements. Without the precise and reliable knowledge of material emissivity it would be difficult to determine the precise temperature of a surface with confidence. Radiation thermometry techniques are used in many industrial applications for temperature determination where contact measurements cannot be used. Non contact measurements of temperature bring many advantages with them compared to contact methods, but still even through great deal of improvement in the recent years still many issues remain that decrease the precision and reliability of these measuring methods. Two fundamental issues associated with the use of radiometric techniques for temperature measurements occur. The first is the unknown emissivity of the object which is necessary to subsequently determine the object's true surface temperature, and the second is the influence of background radiation from nearby objects and the emission from and absorption by the environment. These issues significantly influence the radiation reaching the detector and the resulting temperature reading. One of the problematic areas that we are going to concentrate on is the determination of emissivity of an unknown material. Commonly used procedures for emissivity determinations are based on knowledge of surface temperature, comparison with a material with a known emissivity, radiometric method and table values for specific material. This paper is going to present a procedure of emissivity determination of a material sample without taking into account the temperature of the sample itself, comparison with a material with a known emissivity or table emissivity values. The principles, results, real application and comparison of this "virtual source method" with previously used methods are presented in the following sections of the paper.