Emissivity Measurements Near Room Temperature for Photovoltaic Applications

Iñigo González de Arrieta [C, S]
Applied Physics II, University of the Basque Country (UPV/EHU), Leioa, Bizkaia, Spain
inigo.gonzalezdearrieta@ehu.es

Telmo Echániz and Raquel Fuente
Applied Mathematics, University of the Basque Country (UPV/EHU), Bilbao, Bizkaia, Spain

Irene Urcelay-Olabarria and Josu M. Igartua
Applied Physics II, University of the Basque Country (UPV/EHU), Leioa, Bizkaia, Spain

Manuel J. Tello
Condensed Matter Physics, University of the Basque Country (UPV/EHU), Leioa, Bizkaia, Spain

Gabriel A. López
Applied Physics II, University of the Basque Country (UPV/EHU), Leioa, Bizkaia, Spain

Emissivity measurements are a useful and versatile technique that can be used for a wide variety of high-temperature or high-vacuum applications, where thermal radiation is the dominant mode of heat transfer. Due to low thermal emission from materials below 100 °C, this temperature region is insufficiently studied, even though it includes some very interesting applications. In particular, radiative cooling of photovoltaic cells has been suggested as a possible solution for the loss of efficiency when operating at a real application temperature (50 °C) instead of standard test conditions (25 °C), since the efficiency of most photovoltaic cells decreases linearly with temperature. In the case of commercial silicon cells, the temperature coefficient can be up to 0.5%/°C, which leads to an overall loss of efficiency of 3 %. Emissivity measurements in this temperature range are complicated because all radiation sources (sample, background, detector) are of the same order of magnitude, but satisfactory results have been achieved for sample temperatures above 40 °C without any alteration to the measurement method previously employed for high-temperature measurements. In particular, accurate results have been measured throughout the mid-infrared spectral range, whereas conventional reflectance measurements with integrating spheres are limited to around 16 μm. This feature has been validated by measuring a dense sample of high-purity alumina, a good candidate for an emissivity reference material. Preliminary measurements on commercial crystalline silicon solar cells and candidate perovskites are also presented.