Normal spectral emissivity depending on atomic composition for two nickel-based and two ferrous-based alloys at 684.5 nm

C. Cagran[1], H. Reschab[1], R. Tanzer[2], W. Schützenhöfer[2], A. Graf[2], G. Pottlacher[1]

[1]*Institut für Experimentalphysik, TU Graz, Petersgasse 16, 8010 Graz, Austria*
[2]*Böhler Edelstahl GmbH & Co KG, Mariazellerstrasse 25, 8605 Kapfenberg, Austria*

The Subsecond Thermophysics Workgroup at TU Graz mainly investigates thermophysical properties, such as electrical resistivity, specific heat capacity and density of solid and liquid metals and alloys as a function of temperature. A fast pulse-heating system is used, which also allows the determination of normal spectral emissivity under pulse heating conditions. For this purpose, a laser polarimeter, proposed in the 1980's and later developed by R. M. A. Azzam for the determination of optical constants without any moving parts, was adapted for this μs-pulse heating experiment.
The change in polarization of a laser beam reflected off the surface of the wire-shaped sample material during a pulse heating experiment enables the measurement of temperature-dependent normal spectral emissivity at melting and in the liquid state at the used laser wavelength. Knowledge of emissivity and its behaviour throughout the liquid phase can improve the understanding of interacting effects between light and the molten alloy. The industrial cooperation partner Böhler Edelstahl GmbH & Co KG is interested in emissivity data for numerical simulations of plastic deformation and remelting processes as well as for process optimisation.

As observed from numerous experiments with various sample materials the liquid state behaviour of normal spectral emissivity at 684.5 nm can be classified into three groups, namely increasing, decreasing and constant emissivity with increasing temperature. Based on this finding, it can be shown that the behaviour of normal spectral emissivity in conjunction with the radiometric temperature measurement is needed to achieve reliable thermophysical properties of liquid metals.

Within this presentation normal spectral emissivity data at 684.5 nm for two nickel-based alloys (Nimonic 80A and Inconel 718), as well as the austenitic steel X2CrNiMo18-14-3 and another ferrous-based alloy at melting and in the liquid state are presented.

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