HIFAN 1831a

Polarization pyrometry: initial proof-of principle experiments

by

P.A. Ni, R.M. More, H. Yoneda, F.M. Bieniosek, W.L. Waldron

from
Lawrence Berkeley National Laboratory (on behalf of U.S. HIFS-VNL)
1 Cyclotron Road, Berkeley, CA 94720
Accelerator Fusion Research Division
University of California
Berkeley, California 94720
and
Chofugaoka Institute for Laser Science, University of Electro-communications

May 2011

This work was supported by the Director, Office of Science, Office of Fusion Energy Sciences, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

This work was supported by the Director, Office of Science, Office of Fusion Energy Sciences, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

Polarization pyrometry: initial proof-of principle experiments.

P. A. Ni, R. M. More, H. Yoneda, F. M. Bieniosek, W.L. Waldron.

Abstract

The conventional pyrometer is based on measuring thermal emission normal to a surface. If the surface emissivity is unknown the final instrument uncertainty can be as high as 20%. A novel approach to determine surface temperature with a greater precision is based on exploiting the polarization properties of emission from a plane surface. In this concept "classical" pyrometry is supplemented with measurements of p and s polarized self-emission at several angles. In the "Fresnel surface" approximation, such emission at a given wavelength is described by two optical coefficients, i.e. refraction, n and extinction, k coefficients. If measurements are performed at two or more angles, n, k (and eventually emissivity) can be determined uniquely thus allowing for the true temperature determination. This talk will report on initial proof-of-principle experiments, where a functioning prototype was applied to tungsten foils ohmically-heated with DC currents up to 2500 K. The temperatures obtained were compared to single channel and multi-wavelength pyrometers and reasonable agreement was found. A more rigorous validation with a thermocouple is discussed.