THE AUSTRALIAN NATIONAL UNIVERSITY

Plasma Diagnostic Solves Steel Industry Problem

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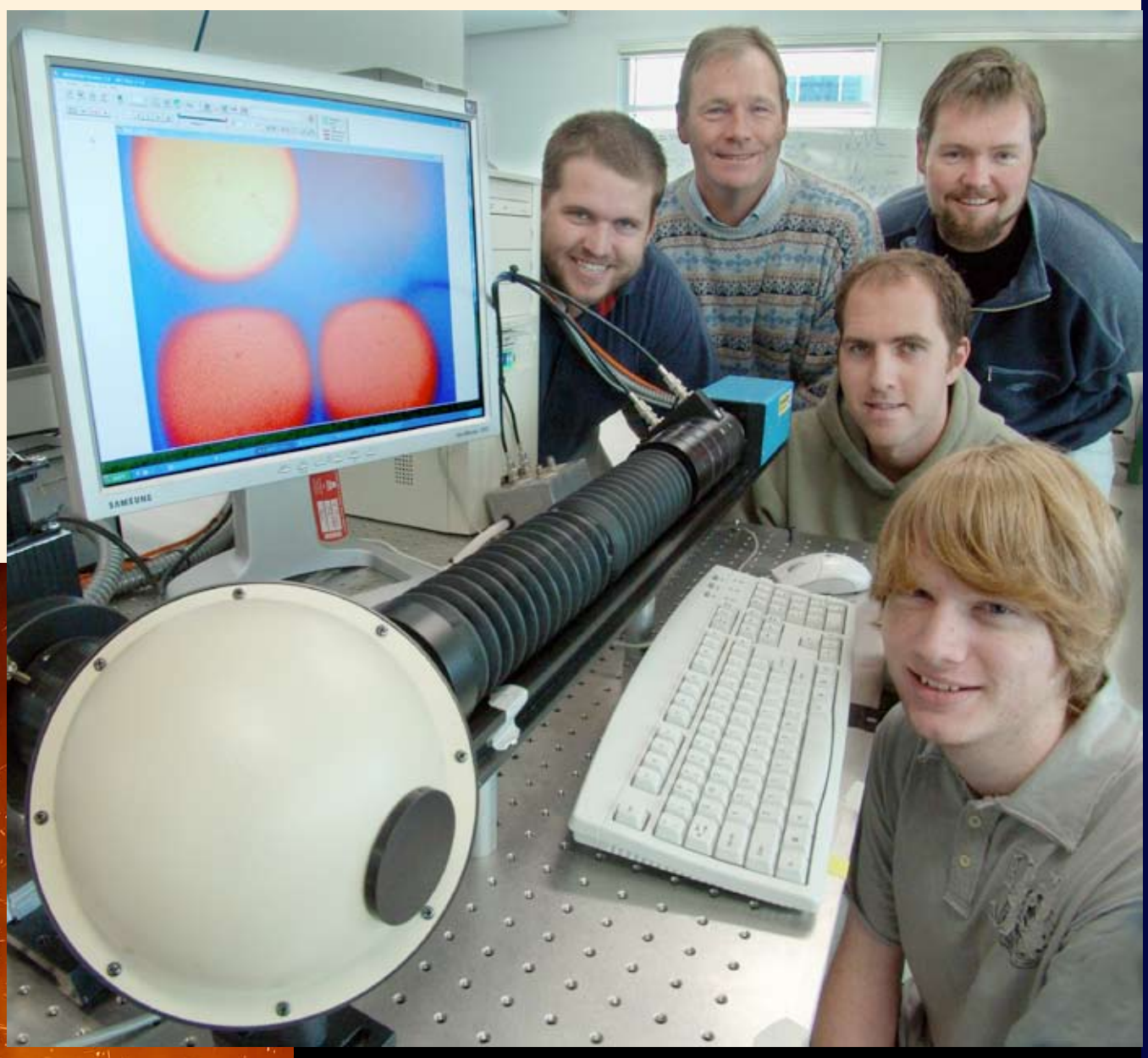
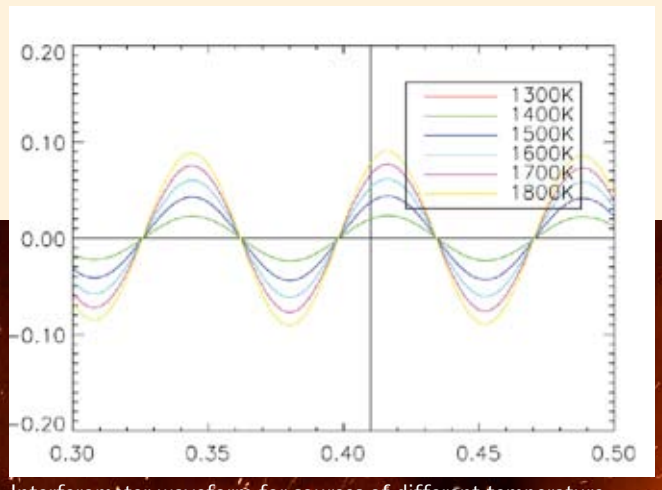


The conventional way to measure the temperature of molten metal is optical pyrometry. This takes advantage of Planck's blackbody law - as surface temperature increases, the peak emission wavelength of a hot object shifts to the blue and the amount of radiated power increases. Pyrometry is effective for some practical situations but it often falls down because most real objects have emission efficiencies that are less than unity, and which depend on the emission wavelength (so called emissivity slope).



Interferometer waveform for sources of different temperature

Photo courtesy US Navy

Prototype MOSS camera undergoing testing at Bluescope Steel

This uncertainty, known as the emissivity problem, presents a particular difficulty in the steel industry because the emissivity of slag and steel are quite different. To the conventional pyrometer hot liquid iron with slag looks exactly the same as even hotter iron with no slag. This confusion not only prevents identification of slag, it also makes reliable measurement of the iron temperature itself, extremely difficult.

However recent work at the ANU may offer an ingenious solution from an unexpected quarter, The Quadrant Coherence Imaging (QCI) Spectrometer - a diagnostic instrument developed for Doppler-based high speed imaging of temperature and flows in superheated plasma.

At the heart of the QCI system is a new type of imaging polarization interferometer. By looking at changes in the interference pattern and applying Fourier theory, it is possible to determine the gradient and brightness of the emission spectrum in a particular wavelength band. By doing this in two adjacent bands it becomes possible to extract information about the emissivity of the material. Furthermore, the ingenious solid state and spatial multiplex design of the interferometer allows the formation of simultaneous 2D images of the temperature, emissivity and emissivity slope.

The differences between the emissivities of steel and slag that confuse conventional pyrometers can now be turned into a positive advantage. Using the QCI technology and computer processing it is possible to produce real time video images of the furnace interior which clearly distinguish slag from steel and which are able to accurately measure the temperature of both.