Enhanced-Contrast Viewing of White-Hot Objects in Furnaces


Marshall Space Flight Center, Alabama

An apparatus denoted a laser image contrast enhancement system (LICES) increases the contrast with which one can view a target glowing with blackbody radiation (a white-hot object) against a background of blackbody radiation in a furnace at a temperature as high as $\approx 1,500 \, ^\circ C$. The apparatus utilizes a combination of narrowband illumination, along with band-pass filtering and polarization filtering to pass illumination reflected by the target while suppressing blackbody light from both the object and its background.

In a typical application, the target is about 1 cm in size and located as far as 30 in. ($\approx 76$ cm) into the furnace. In the absence of this or another contrast-enhancing apparatus, a white-hot target in a furnace is nearly or totally indistinguishable from the white-hot background. Unlike a prior contrast-enhancing apparatus that utilizes two intersecting optical axes for viewing and illumination of the target and requires a furnace opening as wide as 3 in. ($\approx 8$ cm) the LICES provides for both illumination and viewing of the target along the same path. Hence, the LICES makes it possible to utilize a narrower opening into the furnace: the LICES can function with an illumination/viewing tube only about half an inch ($\approx 1.3$ cm) wide.

The LICES (see figure) includes a laser aimed perpendicularly to the optical path to the target. (Optionally, another source of narrowband illumination could be used.) The laser light impinges on a polarizing beam splitter that turns the light onto the optical path to the target. The laser light passes through a quarter-wave retardation plate, which causes the light to become...