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A High-Speed Spatial (Linear) Scanning Pyrometer: A Tool for Diagnostics, Temperature Mapping, and Property Determinations at High Temperatures

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Development of a fast spatial scanning pyrometer for temperature measurements above 1500 K is described.

The salient features of the pyrometer are:

1. it measures spectral radiance temperature (at 0.65 μm) at 1024 points along a straight line (25 mm long) on the target,

2. it has no moving parts and uses a self-scanning linear array of silicon photodiodes as the detector,

3. its output is recorded digitally every 1 μs with a full-scale resolution of about 1 part in 4000, permitting performance of a complete cycle of measurements (1024 points) in about 1 ms.

Operational characteristics of the pyrometer are given. Examples of measurements of the temperature along rapidly heated (resistive self-heating) specimens (rod, tube, strip) are presented. Potential use of the pyrometer in experiments, both ground-based and in microgravity, requiring temperature mapping and property determinations of the specimen at high temperatures is discussed.

A HIGH-SPEED SPATIAL (LINEAR) SCANNING PYROMETER: A TOOL FOR DIAGNOSTICS, TEMPERATURE MAPPING, AND PROPERTY DETERMINATIONS AT HIGH TEMPERATURES

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Abstract

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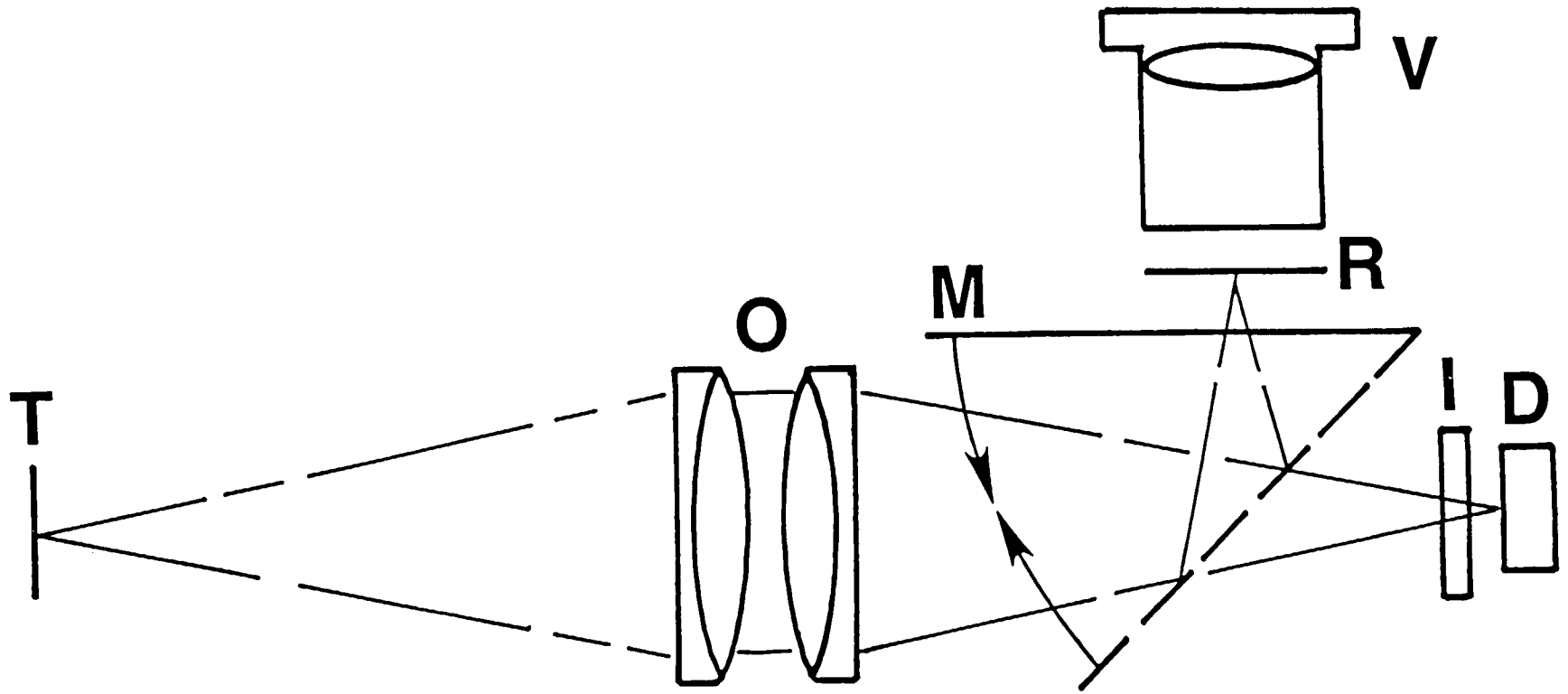

Fig. 1. Schematic diagram of the spatial (linear) scanning pyrometer where T is the target, O is the objective lens (1:1 magnification), I is the interference filter (40 nm bandwidth centered at 650 nm), D is a 1024-element silicon photodiode linear array, V is the viewing eyepiece, R is a reticle and M is a movable mirror.

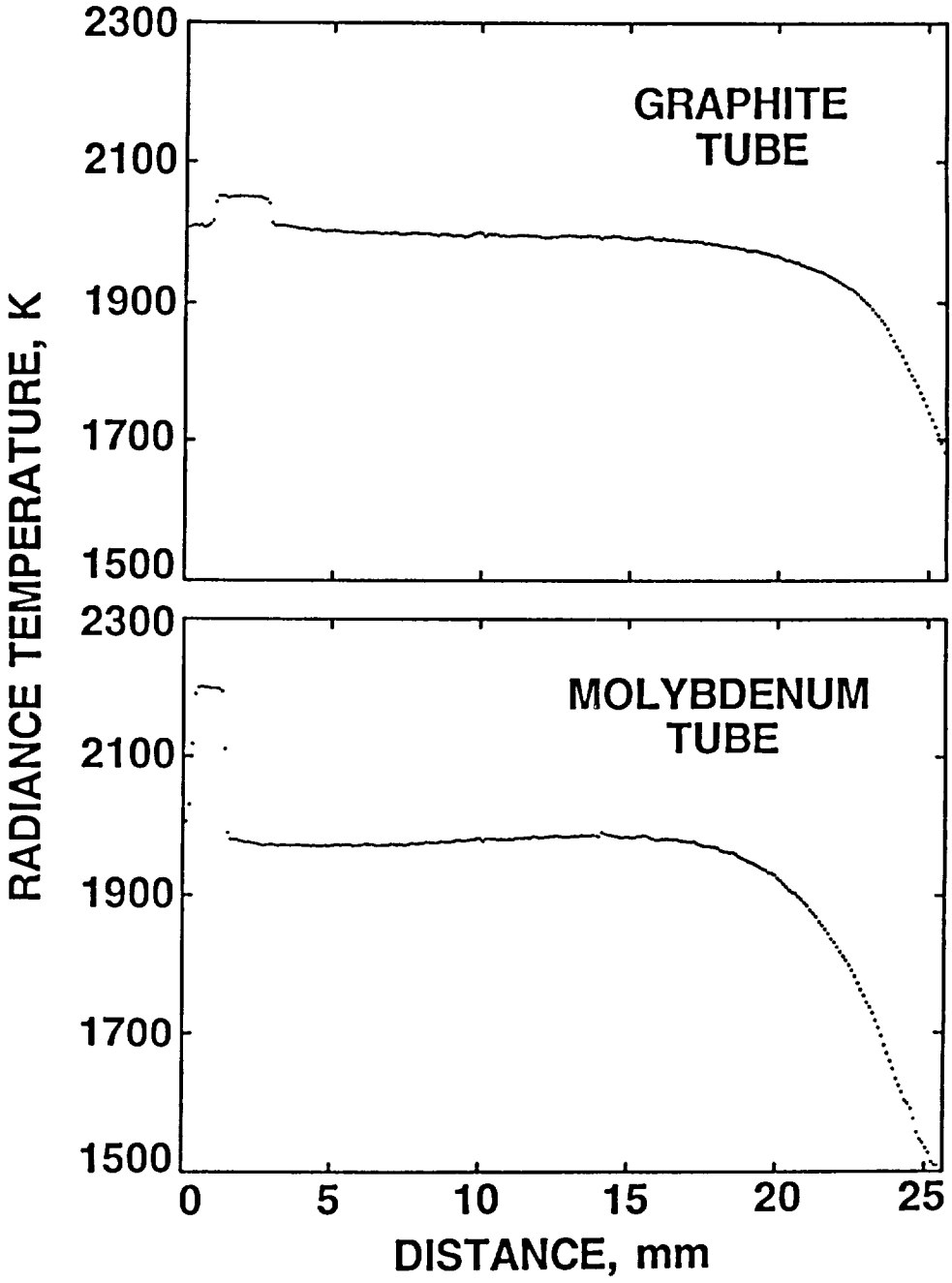

Fig. 2. A profile of the radiance temperature as measured by the pyrometer in a (1 ms) scan along one-half of a graphite tube (upper) and a molybdenum tube (lower) during rapid pulse heating. The region of increased radiance (left) is due to a small "blackbody" hole fabricated through the wall near the middle of the tube. A large temperature gradient (right) is observed along the specimen near the water-cooled clamp.

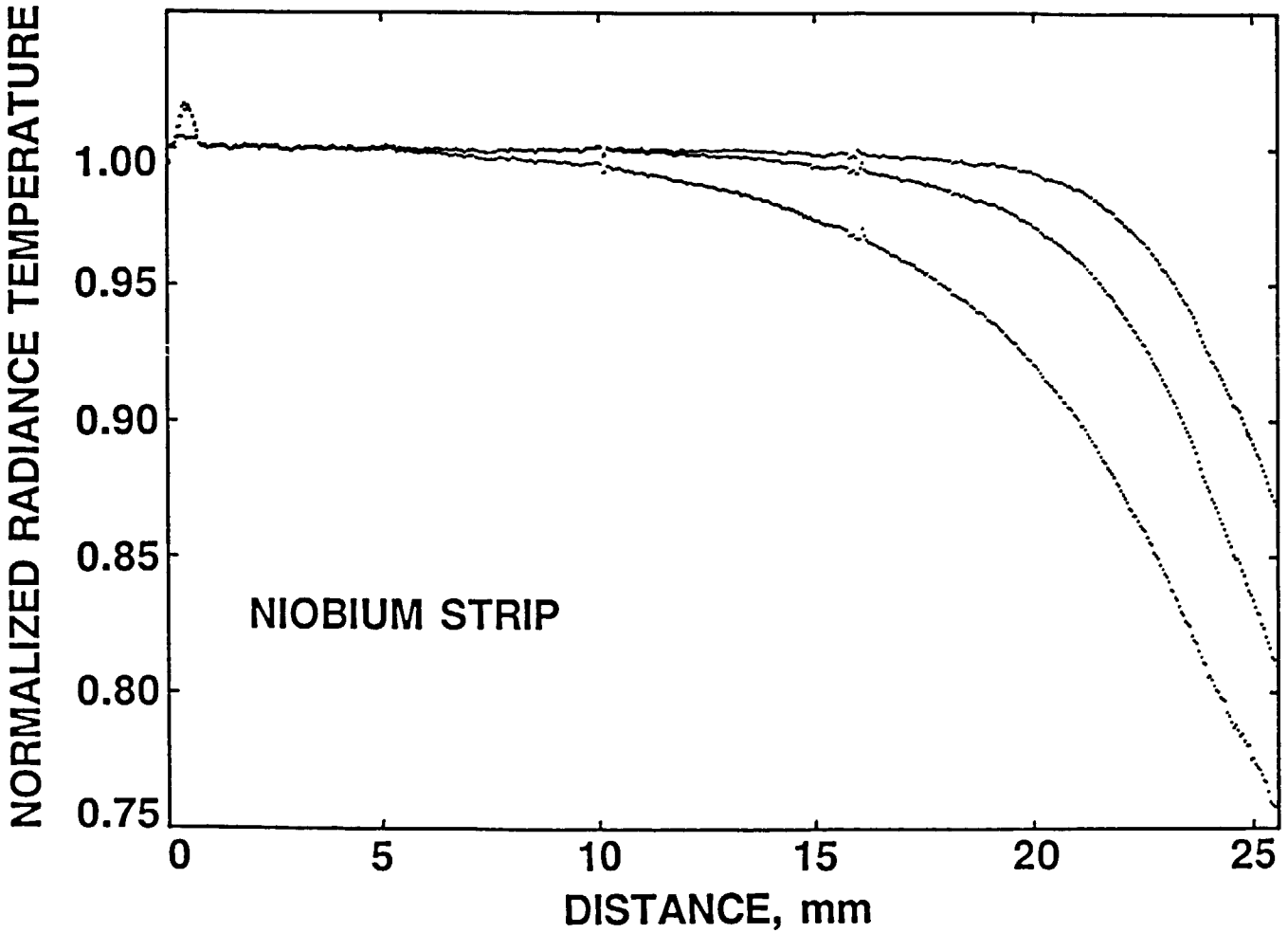

Fig. 3. Profiles of the radiance temperature as measured by the pyrometer in 1 ms-scans along one-half of a niobium strip during pulse heating at three different rates: highest heating rate (uppermost profile), lowest heating rate (lowermost profile).