Temperature and heat flux errors associated with thin film thermometry

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Abstract

Thin film sensors are often used in applications where rapid measurements of surface temperature are required. These gages are typically vapor deposited onto a non-conducting substrate surface and electrically connected with small wires through access holes to the surface. The time response of the gage is measured in milliseconds and surface temperature data obtained with this gage is often combined with a pseudo-inverse heat conduction algorithm to provide information about the surface heat flux. However, the thermal mass of the connecting wires, though small in absolute terms, is large compared to that of the thin film, and the capacitive effect of this mass gives rise to distortions in the temperature field in the area of the gage, resulting in a small error in the sensed temperature. This temperature error, when used in the inversion for heat flux, also results in an error.

In this report, a detailed model of a particular thin film gage is used to compute the response of the sensor to supposed heating conditions. The response of the sensor and the undisturbed surface temperature are compared to estimate the temperature error. Finally, the error in the computed heat flux is determined.