# ASSESSMENT ON THE USE OF A LASER TO DETERMINE THE THERMAL PRODUCT OF THIN FILM GAUGE SUBSTRATES

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The experimental determination of the convective heat transfer coefficient around a blade can be obtained using the thin film technique in a blowdown facility. A thin film gauge consists basically of a very thin strip of metallic material (platinum) deposited on a ceramic substrate (MACOR). These thin film gauges allow to measure the temperature history at the wall during the gas temperature transient blowdown. With the latter, the 1D unsteady conduction equation into the substrate can be solved, the heat flux computed and thus the heat exchange coefficient.

The determination of the thermal product of the substrate, $\rho c k^{0.5}$, is of prime importance because it links proportionally the wall heat flux to a function that has for argument the measured surface temperature. An experimental determination of this quantity is needed, as it is believed that the way these gauges are manufactured may change the bulk properties of the ceramic material. Thus, proper calibrations for the different platinum gauges have to be developed.
The present work is an experimental investigation to assess a new technique to calibrate these substrates heating the gauge surface wit an Argon laser beam. The most widely used technique up to now is the electrical discharge method, that consists of heating the gauge by Joule effect. Although it is a well-established technique it presents an important limitation. The heated area is limited to that of the gauge and as a result, the unsteady heat transfer does follow the 1D equation only for very short time (2 ms). Thus, the higher area heated with the laser, previously expanded by means of lenses, represents, a priori, a great advantage.

The laser beam power profile and the amount of reflected light have been estimated. Single layer and double layer gauges were tested. They were both submitted to a heat flux laser source, and corresponding thermal products determination attempts were performed. The heat flux received by the gauges was also calculated. When dealing with single layer probes, a surprising peak in the heat transfer rate was achieved in the beginning part of the curve, whereas a step function was expected. The technique provided longer one-dimensional times, and good levels of signal to noise ratio. Calibrations seemed reliable for both kinds of gauges, but care has to be taken when choosing the proper slope time intervals involved in the thermal product calculation.

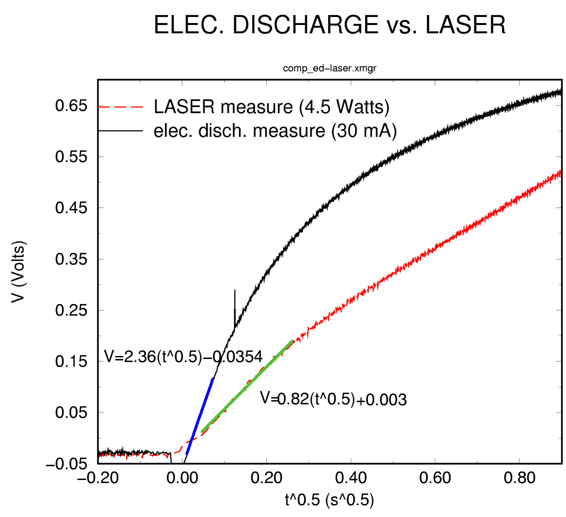


*Figure 1:. Comparison e/d vs laser*

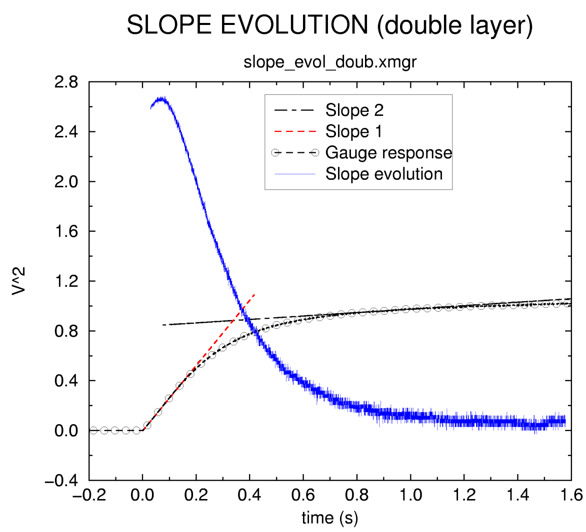


*Figure 2: Double layer test*