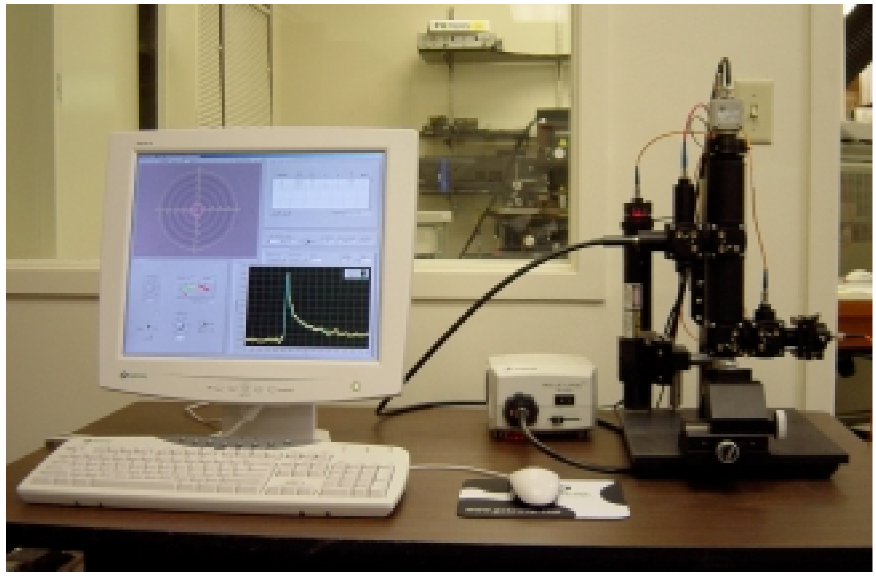
MetaTechnica

Transometer

New, Compact Thermal Properties Measurement System

- **Simultaneously measures the thermoconductivity of thin films and the thermal interface resistance between them**
- **Able to measure thickness of opaque materials (thin film metals or semiconductor layers)**
- **Single measurement based on hundreds of laser shots takes less than a minute and has remarkable accuracy**
- **Lasers power delivered via fiber**



System description

The underlying mechanics of Transometer consist of the use of a pulsed laser to heat the surface of a sample under test, and a CW laser (of a different wavelength) to probe the heated surface of that sample. The measurement system is based on the principle that the reflectance of a material changes linearly with temperature in a small, but quantifiable, way. It is those changes that the probing laser is intended to help reveal by having the laser energy reflect back from the sample surface onto the active area of a photodetector. Since the amount of reflected irradiation is affected by the reflectivity of the surface, changes in that reflectivity result in variations in the output signal of the photodetector. That signal is registered in the memory of a digital oscilloscope and the data is captured for further analysis.

The “pump-and-probe” system combines the ability to view the sample under test concurrently with the measurement capability provided by the combination of the heating Nd:YAG laser and the probing He-Ne laser. The diameter of the round probing spot can be varied by use of different objective lenses and minimized down to the diffraction limit of 0.7 μm with the 100X objective lens. The diameter of the concentrically positioned round heating spot remains at least one order of magnitude larger than that of probing spot supplying a speed of one dimensional approach to the heat transfer problem numerical simulation. The reflected probing laser irradiation, which contains the measurement signal, is collected through an optical fiber on the sensitive area of a fast, preamplified, Si PIN photodiode, which is connected to an oscilloscope board. The state-of-art digital oscilloscope board is integrated within a PC, significantly reducing the physical footprint of this novel TTR system. The oscilloscope board, which has a sampling rate of five (5) Giga-samples per second and a dynamic range of eight (8) bits, provides superior temporal and dynamic resolutions for the acquisition of the nanosecond transient signal.

A software package with multi-parameter optimization capability and an interactive graphical user interface has been designed to automate the measurement and computation procedures. The user need only to place the sample on the holder, decide which variable is of interest (thermal properties or thickness of one layer), and enter values for the other unknowns. The computational technique is fully automated and consists of the inverse solution of the heat transfer problem describing the volumetric irradiation heating of a multi-layered sample of a potential combination of semiconductor, dielectric, and metallic materials. The solution technique involves the iterative matching of the numerical and measured data until the RMS error between them is minimized.

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