

MatCalorie™ – Absorption measurement for laser optics

Introduction

Absorption coefficients of optical components in high power applications is an important parameter in determining the quality of optical components. Optical components with higher absorption coefficients absorb a larger proportion of the optical beam which may result in thermal runaway. This phenomenon affects the quality of laser beams, undermining the quality of laser machining processes. As such, it is important for end-users to employ optical components with small absorption coefficients.

Operation Principle

MatCalore™ is the world's first commercial absorption measurement system for optical components. In compliance with ISO standard, this instrument is based on the principle of calorimetry where the optical component is illuminated by a collimated laser beam. A portion of the laser energy is absorbed and converted to heat which manifest as temperature rise of the optical component under testing.

The system is fully automated, customizable to laser operating wavelength at 1 μ m and 10.6 μ m calorimetric measurement to determine the total (surface and bulk) absorption coefficient of relatively thin samples (2mm-9mm). It is operational in transmission and 0/45° reflection modes.

The key specifications are listed in table 1:

Model	Mat'C-1 μ m	Mat'C-10 μ m	Mat'C-1 μ m-10 μ m
Laser Source	YAG	CO2	YAG & CO2
Wavelength	1 μ m	9.4/10.6 μ m	1&10.6 μ m
Power	~10 W		
Stability	< 10%	<3%	< 3% & <10%
Alignment	Visible beam		
Samples	Transmission windows, focusing lens, reflective mirrors, etc.		
Absorption resolution	0.01%		

Table 1. Key specifications of MatCalorie™

The key indicative features of our product are its compact size and the design of the vacuum chamber that allows for its compact size. Other features include automated functions to provide a turn-key solution for absorption coefficients measurements at the factory-

floor. The laser calorimetry design is based on duo-sensor differential thermal measurement. Multi-effect scattering elimination has been achieved by miniaturized chamber design. Three-point algorithm has been implemented in the software. The improvements of the developed calorimetry system over competitive technologies, albeit non-commercially available, are high resolution, simplicity and cost effectiveness. The innovation has been featured by SPIE in 2014.



Figure 1. Mid-IR MatCalorie equipment

Applications

The system now boasts industry 4.0 capability, integrating system data as a feedback to determine the health of the components in the system. This technology ensures maximal functionality for absorption measurement.

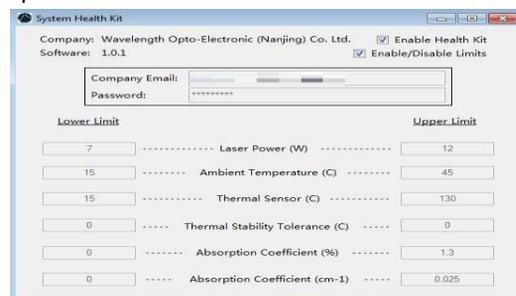


Figure 2. MatCalorie GUI

The system could be used in but not limited to the following application scenarios:

- Bulk absorption of new/unique materials
- Bulk absorption of material used in 3D additive manufacturing
- Coating quality and substrate characterization in manufacturing processes
- Applicable Materials: ZnSe/Fused Silica/Copper Mirror/Diamond/Polished Steel etc.

Conclusion

As a global enterprise, leading photonics innovation since 2002, WOE has built up customization engineering capability for precision measurement instrumentation.

