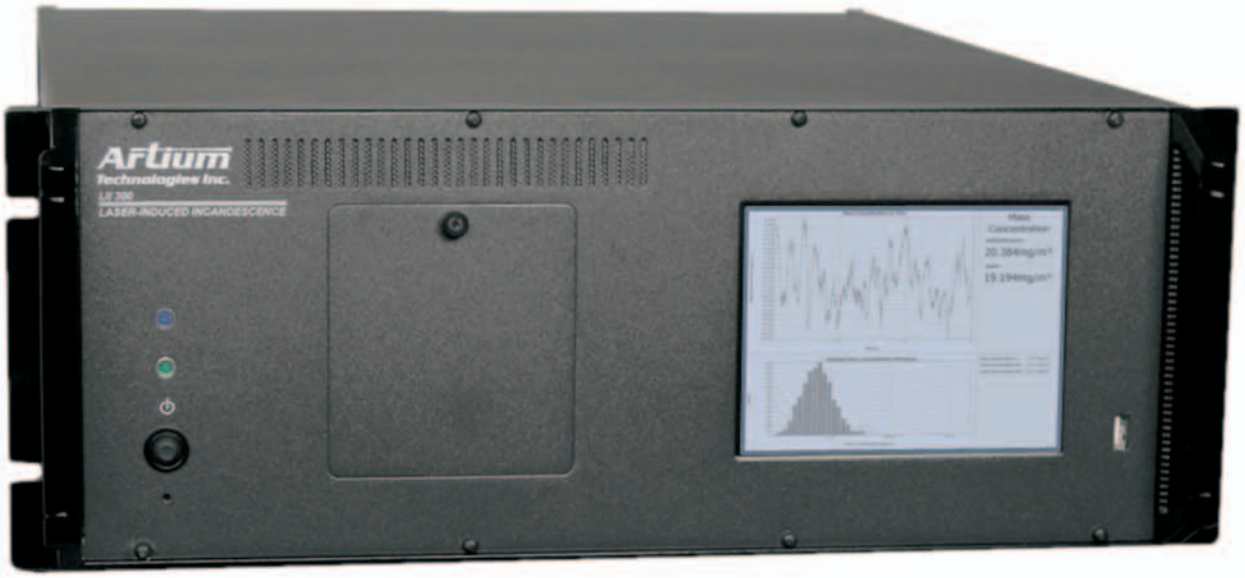
LaVision

We count on Photons

Artium Technologies Inc.

Developing Advanced Instruments for Energy and Environmental Research and Development

LII 300



LII 300 LASER-INDUCED INCANDESCENCE Instrument for Soot Characterization

Artium Technologies, Inc. introduces the **LII 300** system, the most advanced laser-induced incandescence instrument available in the market today. Laser-induced incandescence is an optical technique for accurate, non-intrusive, and temporally resolved measurement of soot concentration, specific surface area, and primary particle diameter.

New Generation LII 300 Instrument Features

- Easy to use
- Low maintenance system
- Low operating costs
- Very high sensitivity
- Compact rugged and portable instrument
- Built-in computer and display, touchscreen control
- Completely enclosed laser, optics, and sampling cell
- Built-in pneumatics controller and sampling system
- Includes real-time pressure and temperature measurements to reduce data to STP
- Fail safe valve prevents sample from entering cell if purge air or power are off

Artium Laser-Induced Incandescence Technology

Laser Induced Incandescence (LII) – involves measuring the thermal emission (incandescent light) emitted from particles heated by a pulsed laser to temperatures in the 2500 K to 4500 K range. A community of science has developed to advance the LII technique at a large number of organizations around the world, and a number of international workshops to assess the improvements in the LII technique have been held since 2005 (e.g. see http://www.liiscience.org). LII is highly selective, responding only to the presence of black carbon, making it decidedly appropriate for measuring the nonvolatile particles produced as a combustion emission. This selectivity is due to the fact that the nonvolatile particles are primarily black carbon. BC absorbs laser radiation over a broad spectral range, and is refractory, so that the nanoparticles survive heating to the temperatures necessary for the incandescence to be detected. At these temperatures, all volatile components that may have been condensed on the BC particles will be promptly evaporated, and most other nonrefractory particles will have also evaporated or undergone sublimation. Due to this selectivity, LII does not measure the total particle mass. Black carbon is the primary and most stable constituent of particulate matter emissions from combustion.

LII Signal Analysis results in the determination of the mass concentration, volume concentration, active surface area, and primary particle diameter of the particulates. In this context, primary particle diameter refers to the geometrical diameter of the spherical black carbon based particles formed during the combustion of hydrocarbon fuels; often these particles fuse together in the combustor to form a single nonspherical larger particle known as an aggregate. LII does not measure the diameter of the aggregates emitted from the combustor. The measurements made with LII are produced with each laser pulse at a 20-Hz rate, permitting online time-resolved data collection and reporting of results in real time.

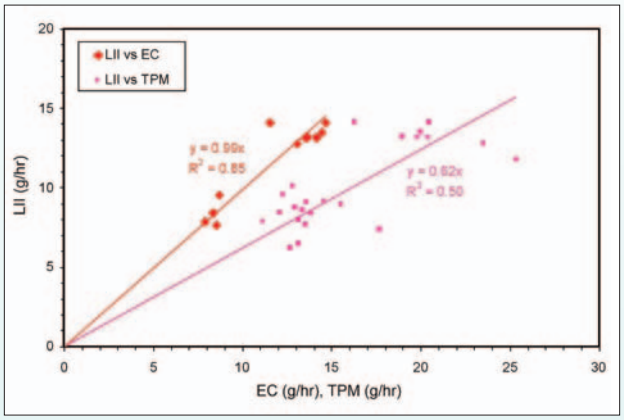
(US Patents 6,154,277 and 6,181,419)

Measures Soot Concentration (mass or volume basis), Specific Surface Area, and Primary Particle Diameter in Real-Time

- Fast, convenient, reliable and easy to use
- Measures raw exhaust or from a dilution tunnel
- No dilution required
- Does not assume the soot aggregate to be spherical
- Proprietary NIST Traceable Calibration method
- Measures soot independent of condensed volatile or organic material (high selectivity)
- Rugged system capable of extended operation without maintenance
- Dynamic Range 1: 1,000,000

LII 300 Key Features

- Top-hat laser beam profile for uniform heating
- Two-color pyrometry for measuring the soot temperature
- Auto-compensating
- Does not require precise conditioning of the sample
- Real-time measurements
- Convenient for laboratory testing
- Vehicle onboard monitoring
- Very large dynamic range



Heavy-duty diesel soot emissions determined by the Artium LII and compared to gravimetricmeasurements of total particulate matter (TPM) and elemental carbon (EC).

What is Soot?

Soot refers to the dry solid particles produced through the incomplete combustion of hydrocarbon fuels.

Other terminology used by specialists from a range of fields to describe similar or identical nanoparticles includes:

- Elemental carbon (EC)
- Black carbon (BC)
- Carbon black (CB)
- Refractory carbon (RC)

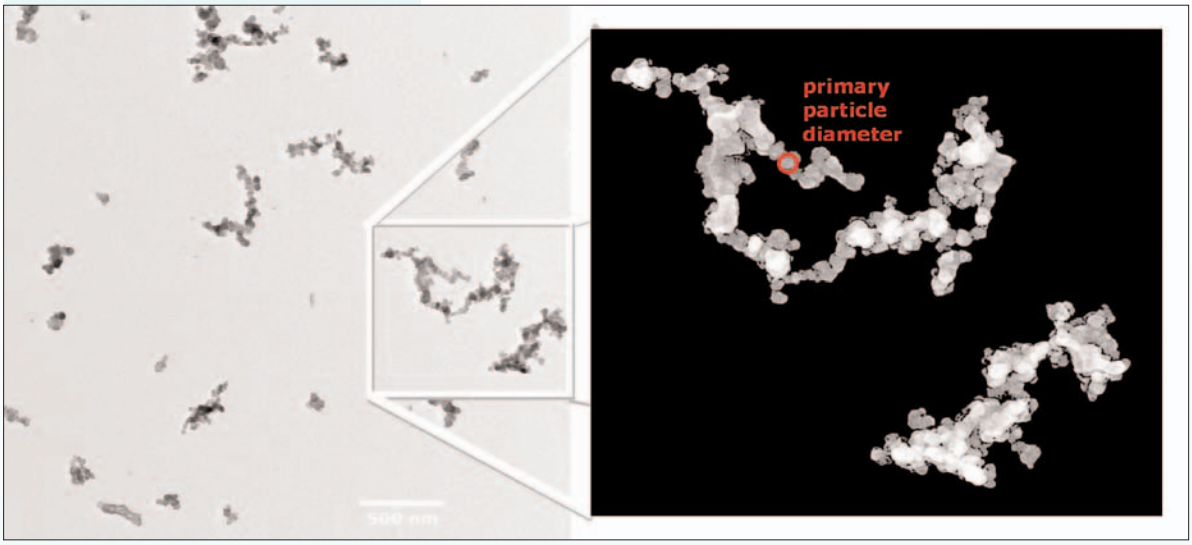
Although the definitions for each may be specific to a field, LII is effective in measuring all of these.

Why are soot emissions a serious concern?

Increasingly, health researchers are discovering that soot itself is implicated directly in the numerous health effects attributed to particulate matter and poor air quality. Medical research over the past decade has revealed that microscopic soot particles are among the most harmful components of air pollution.

Environmental researchers have identified black carbon as a key contributor to radiative forcing, which is important to climate change.

Due to its low reactivity and low volatility, soot can be reliably measured regardless of temperature and dilution conditions that affect many of the other constituents of particulate matter.



TEM image of soot nanoparticles showing the irregular structures of the aggregates.

Ease of Use

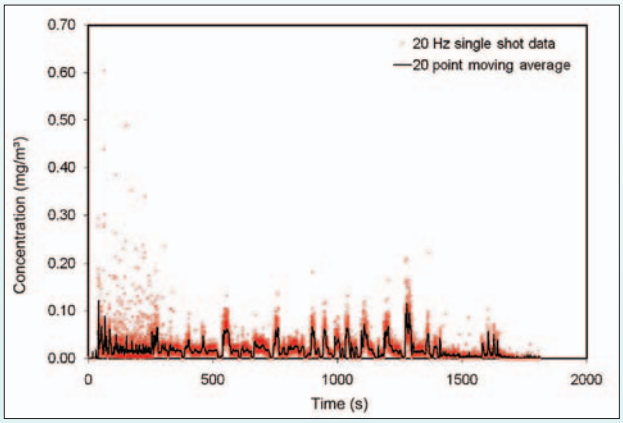
The **Artium LII 300** instrument is configured for quick set up and unattended operation.

Connections:

- Sample line from source of particulates
- Exhaust line
- Standard electrical outlet
- Compressed air source
- Data line to acquisition system

Operation:

- Simple start/stop from touch screen interface
- Remote control option



On-road measurements of diesel soot acquired in real-time from an unattended Artium LII instrument. Single-shot results (red dots) and 20-shot running average (black line) are shown.

Auto-compensating LII (AC-LII)

Auto-compensating laser-induced incandescence (AC-LII), has emerged which further enhances the LII technique by recording the temperatures of the irradiated particles during the LII process. This new technique automatically compensates for any changes in the experimental conditions, including fluctuations in local ambient temperature, variation in laser fluence, laser beam attenuation by the particulate matter, or desorption of condensed volatile material. The LII 300 instrument produced by Artium Technologies distinguishes itself from other LII instruments by being the only commercially available instrument offering AC-LII.

AC-LII is based on the use of a traceable calibration source to establish the spectral sensitivity of the instrument to incandescence.

Measurement at two distinct spectral bands enables real-time two-color pyrometry to measure particle temperature. This automatically compensates for:

- Fluctuations in local ambient temperature
- Variation in laser fluence
- Laser beam attenuation by the particulate matter
- Desorption of condensed volatile material

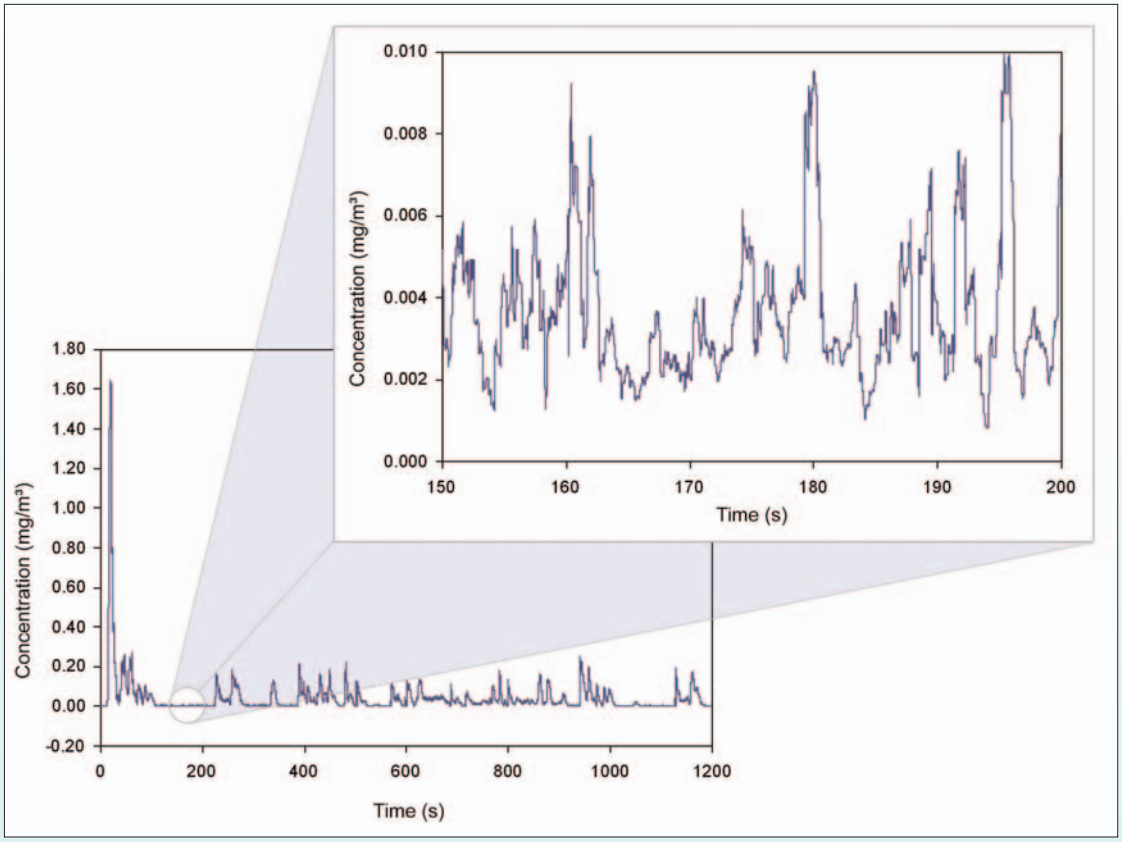
These are issues that often affect conventional laser-induced incandescence (LII).

LII 300 Applications

The LII 300 can be applied to measure soot in many applications, including:

- On-road mobile emissions
- Diesel engine exhaust
- Gasoline engine exhaust
- Diesel particulate filter performance
- Advanced and alternative fuels, including biofuels
- Urban air quality
- Ambient air monitoring
- Atmospheric black carbon levels
- Gas turbine particulate emissions
- Carbon black production

For engine emissions, LII 300 may be reliably applied directly to raw exhaust or to dilute exhaust.



Demonstrated sensitivity (<2 µg/m3) and time response (20 Hz) of Artium LII instrument.

Post DPF (diesel particulate filter) soot emissions from a 2007-compliant heavy-duty diesel engine operating on the EPA FTP cycle.

Specifications

All Measurements:

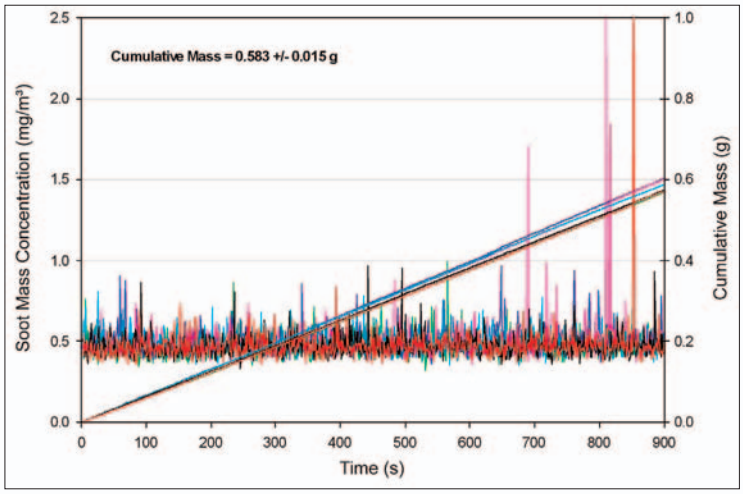
Sampling Frequency:	20 Hz

Concentration:

Low end	<1 part per trillion
	<2 micrograms/cubic meter
High End	10 parts per million
	20 grams/cubic meter
Range	>1,000,000:1
Precision	+/- 2%

Primary Particle Size:

Range	10–100nm
Precision	+/- 2% of max.
Specific Surface Area:	50-200 m^2/g



LII demonstrates better than 3% repeatability on heavy-duty diesel steady-state testing.

Artium Technologies, Inc. was founded with the goal of developing and commercializing advanced laser-based instrumentation for energy, environmental and health related applications. We were the inventors and first developers of the Phase Doppler Interferometry method which is the worldwide standard for spray characterization. We received a first grant from NASA Glenn Research Center and subsequently from EPA, NIST, and California Air Resources Board (CARB) to support the development of our innovative laser-induced incandescence technology and to commercialize the LII instrument.

Artium Technologies Delivers Customer Satisfaction

We offer support from our headquarters in Sunnyvale, California plus a network of professional representatives in the major industrialized countries around the world.

Artium Technologies, Inc. is committed to supporting its clients through:

- Product quality
- Training and Support
- Warranty support
- On-site installation
- Field service
- Custom configuration on demand

*Research and Development supported by NASA Glenn Research Center, EPA, NIST, California Air Resources Board (CARB), and NRC Canada.

US Patents: 6,154,277, Nov. 2000; 6,181,419, Jan. 2001 • Licensed from National Research Council (NRC) Canada

Artium Technologies Inc.

ARTIUM TECHNOLOGIES INC. | 150 W. IOWA AVENUE | UNIT 202 | SUNNYVALE | CA 94086 | WWW.ARTIUM.COM
TEL: (408)737-2364 | FAX: (408)737-2374 | EMAIL: INFO@ARTIUM.COM