SCIENCETECH

MODULAR OPTICAL SYSTEMS AND COMPONENTS

SOLAR SIMULATORS
SPECTROSCOPY
PV CHARACTERIZATION & CUSTOM SOLUTIONS

www.sciencetech-inc.com
Established in 1985 by three physicists and one engineer.

Currently 33 employees, about half holding advanced degrees in Physics, Chemistry, Chemical Engineering and Mechanical Engineering.

Sciencetech is a 930 m² manufacturing facility in London, Ontario Canada which is currently being expanded.
### Main Products
- Solar Simulators
- Photovoltaic Testing Solutions
- Modular Spectroscopy
- Electrochemical Work Stations

### Main Applications
- Aerospace
- Cosmetic Testing
- Photovoltaics
- Photochemistry
- Materials Science
Solar Simulators

Sciencetech Solar Simulators comply with the following international standards:

- **ASTM E927**: Specification for Solar Simulation for Photovoltaic Testing,
- **IEC 60904-9**: Solar Simulator performance requirements.
- **JIS C 8912**: Solar simulators for crystalline solar cells and modules.
- **IEC 61215**: Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval.
- **IEC 61646**: Thin-film terrestrial photovoltaic (PV) modules – Design qualification and type approval.
Low Cost, Lens Based Solar Simulators

SF Series
• 300 - 2000 nm
• Xenon arc lamps: 150W, 300W
• Class AAA
• Collimation: 1.0 ° half angle (highly collimated)
• Target size up to 50 mm diameter
• One sun irradiance

SLB Series
• 350 – 2000 nm
• Xenon arc lamps: 150W, 300W
• Class AAA
• Target size up to 50 x 50 mm squared area
• One sun irradiance
Fully Reflective Solar Simulator

- Metal coated mirrors allow for the whole spectrum to be passed without compromise.
- We have four high powered versions of fully reflective solar simulators using xenon arc lamps of 0.5 kW, 1.0 kW, 1.6 kW and 2.5 kW.
- Sciencetech also manufactures small 150W high efficiency solar simulators.

★ Hexagonal segment mirrors for exceptional uniformity and high efficiency

- 300 nm – 2000 nm
- Up to Class AAA
- Up to 2 suns irradiance
- Target size up to 34 cm diameter
Large Area Solar Simulators (LASI)

- 0.5 x 0.5 m – 3 x 3 m target ranges are available.
- Consists of a light source, beam homogenizer, power supply and necessary IR filter to adjust to the solar spectrum.
- Uses a 1600W Xenon Arc Lamp with a spectral range of 350-1800 nm. Lamp power can be customized.
- Sciencetech manufactures custom products to fit your requirements for target area, collimation, power output and spectral ranges.
- Additional accessories: System Enclosures, IV Test Equipment, Custom Filters, Calibrated Reference Cells etc.
Other Solar Simulators for Larger Areas

Flash Solar Simulators

- Class AAA
- Generally uses 1000W Xenon lamp
- Pulse duration: 0.5 – 10 ms
- Target Size: up to 2m × 2m
- One of the largest, most uniform solar simulators currently available on the market.

LED Solar Simulators

- Target areas from 7 cm x 7 cm up to 2m x 2m
- AAA Standard
- Light Source: 16 LED channels
- Reduced Operating Costs: 30-70% lower power consumption.
Highly Collimated Fresnel Solar Simulator

- Highly collimated with a half angle of 0.5 °
- Target area diameters: 22cm – 30 cm.
- One sun (AM1.5D) intensity level.
- Fresnel lenses are used as optics.

Ultra High Efficiency (UHE) Solar Simulators

- Class AAA
- Lamp type: Xenon Arc lamps from 150 - 300 W)
- Target size up to 30 x 30 cm.
- Customization can be done according to your needs!
- Please contact one of our technical representatives for assistance.
The UHE-NS/NL family of solar simulators are ultra high efficiency, convenient, integrated workstations which use a uniform xenon light source.

- Uses Xenon lamps: 150 – 1600W. Can be customized accordingly.

- Produces 1 Sun (±10%) solar irradiance. Illumination area 50x50 mm² – 300x300 mm²

- Provide Class AAA with downward facing or horizontal beams.

- Spectral range 300-1800 nm

- Maintains Scincetech’s proprietary “Fully Reflective” design maximizing ultraviolet light.
Fiberized Solar Simulators

A4 Light line

- Up to 12 suns radiation at target plane
- Xenon lamp sources (300-1000 W)
- Class AAA Standard
- Up to 50 x 50 mm target size

A1 Light line

- Up to 4 suns radiation at target plane
- Xenon lamp source: 300 W
- Class AAA Standard
- Up to 25 x 25 mm target size

Brings the light source to your sample!
Solar Simulator Work Stations

- Features a convenient bench-top configuration with automatic shutter, beam turner for vertical beam orientation, and 2-position filter holder.
- Xenon arc sources: 150 – 300 W
- Spectrum range 350 nm – 2000 nm
- Produces Class AAA standard
- Target size up to 60 mm × 60 mm
- Up to 2 suns irradiance at target plane
- Excellent choice when collimation and significant UV light are not needed.
Photovoltaic Testing solutions

- IV measurements, Spectral Responsivity and External and Internal Quantum Efficiency available with the system.

- Additional methods include: Constant Photocurrent, Dual Beam Photoconductivity, Photothermal Deflection Spectroscopy, and Steady State Photoconductivity.

- Uses a 150W Xe arc lamp or 250W QTH tunable source for the monochromator with motorized triple grating system.

- 75W Ultra-stable biased light with a calibrated range of 250-2500 mm in the reference detector.

- Stanford Lock-in Amplifier SR800 series for data acquisition, Keithley 2400 sourcemeter, order sorting filters, and IV testers are all included.
Quantum Efficiency and Spectral Responsivity

- Light Source, Source Modulator, Monochromatic Source, Order Sorting Filters, and Xenon Bias Light integrated into top area
- Optical system: beam turners for monochromatic and white light
- Optical chopper controller
- Lock-in amplifier for synchronous detection: Stanford 800 series
- Source Meter: Keithley 2400 series (for biasing the Device Under Test (DUT))
- Light tight enclosure
- DUT: cell chuck and detector
(PTS-LED-QE) Quantum Efficiency System

- Spectral output is controlled by individual LEDs and includes IV measurements, Spectral response and QE system.
- Less expensive and simpler compared to a standard Laboratory EQE measurement system.
- Power and spectral response measurements can be combined in a single tool saving valuable processing time.
- Illuminating cell size 2 x 2 cm with a class AAA solar simulation.
Modular Spectroscopy

Sciencetech Modular Spectroscopy Systems give you the ultimate flexibility
Modular Spectroscopy

- Tunable Light Sources
- Fluorescence Spectrometers
- Fourier Transform Spectrometers
- Raman Spectrometers
- Spectroradiometers
- Spectrophotometers
- Laser-Induced Breakdown Spectrometers
Research Grade Light Sources

- Light Sources available from the deep UV to the far IR, in Collimated or Focused, Non-Tunable or Tunable variations.
- Power input can be varied from 75W to 6.5kW, operates vertically or horizontally.
- Optics can be inserted as your choice, depending on your research needs.
Monochromators

Double additive/subtractive and triple monochromators are available!

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<tr>
<td>Turret Configuration*</td>
<td>S (32 × 32)</td>
<td>T (30 × 30)</td>
<td>D (50 × 50)</td>
<td>T (50 × 50)</td>
<td>T (64 × 64)</td>
<td>T (64 × 64)</td>
<td>T (64 × 64)</td>
<td>S (110 × 110)</td>
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</table>

*(S for single, D for double, T for triple, grating size mm × mm)
Fourier-Transform Terahertz Spectroscopy
THz FTIR SPS-300

“Every SPS is a work of art.”
– Terry Barnes, Manufacturing Technologist in Sciencetech

- Modified Michelson (Martin-Puplett) Interferometer, vacuum compatible, helium cooled bolometer

- Designed specifically to operate in the far infrared or THz spectral region (operating at wavelengths from 5 μm to 5000 μm, 0.06 to 60 THz or 2 cm⁻¹ to 2000 cm⁻¹)
Laser Induced Breakdown Spectroscopy (LIBS)

- At Scienctech we pride ourselves in providing custom solutions for your atomic emission spectroscopy needs.
- LIBS can analyze any matter regardless of its physical state.
- With our modular instrumentations, we can customize and cater the system to your needs.
- Whether this involves increased resolution requirements, a unique probe design or incorporation into an existing system, we have the capacity to design an ideal solution.

This configuration template is meant as a guide for our LIBS system and does not represent a concrete schematic.
Custom Solutions

Sciencetech offers custom solutions from light sources to spectroscopy systems that specifically fit your research or industrial needs.

A few of our diverse custom projects and large scale manufactured equipment are listed in the following slides.
IR Solar Simulator for 3D Camera Testing

- Target Area $1 \times 1$ m meeting $\pm$ 5% Non-uniformity.
- Target Area $1.5 \times 1.5$ m meeting.
- Spectral match better than ASTM Class A for 700 nm – 1000 nm.
- Power and uniformity maintained over 30 cm depth.
UV Solar Simulator for Air-pollution Studies in the Upper Atmosphere

- Solar simulator illuminates a rotating cylindrical drum designed to hold aerosols in suspension.

- 6.5 kW Light Source, 0.5 m² target area with a beam collimation of 1° half angle.

- AM0 spectral match with variable intensity from 0.25-1 sun and ambient room temperature is to be kept below 23°C.

- All equipment in the system were to fit within a room of dimensions ~3m width by ~5m length by 2.5m height.

- The intensity, cross sectional area, room size, and cooling requirements made the system a significant engineering challenge which Sciencetech was able to successfully overcome.
Large Area QTH Solar Simulator

- Consists of multiple QTH sources and illuminates a target area of 1.5 x 1.5 m.
- Wavelength ranges from 700-1100 nm at one sun intensity of AM1.5G Class.
- Temporal Instability of Irradiance +/-5%.
- Attenuation down to 0.1 Sun for the 700-1100 nm wavelength range while maintaining the color temperature to within 10%.
Large-area Solar Illuminator for PV Testing in Extra-terrestrial Planetary Conditions

- 6.5 kW Xenon Arc Lamp
- Target size 1m x 1m
- Uniformity ±25%
- Temporal Stability 2%

40 cm long quartz homogenizing rod for non-uniformity requirement


Standalone Solar Simulator (SS) and Moving System (MS)

The Moving System controls the position and incident angle of the SS which is mounted on top of the System.

- 0.5° full-angle collimated beam is 400 mm in diameter, 1 sun with AM0 spectral match at a 3 m working distance.
- Beam can be translated 60 cm in the X and Y directions, 40 cm in the Z direction and can rotate ±15° both about the X-axis and the Z-axis.
- Extraordinary effort was put into providing the highest level of temporal stability (0.2%) and 3% spatial non-uniformity of irradiance in the full range of the incident angles.
10 kW Spot-Focused Image Furnace for Ultra-high Temperature Oxidation Studies

- Four 6.5 kW Xenon Arc Lamps
- Target size 5 cm diameter
- More than 10 kW optical power at target plane

Screw melts in 30 seconds with only 20% power
Dual Wavelength Fast Time-Gated Laser Induced Fluorescence System (TGF)

- The TGF measure time gated fluorescence from a sample using laser induced fluorescence (LIF) method.
- TGF allowed for the excitement and spectral measurement of fluorescence of samples at two distinct laser lines (351 nm and 262 nm).
- Sample excitation is based on two newly introduced Neodymium Yttrium-Lithium-Fluoride lasers.
- The induced fluorescence is spectrally dispersed and then measured with a nano-second time gated camera.
Electrochemistry

Zahner electrochemistry (in Canada only)
Applications include corrosion, coating, Li-ion battery, fuel cell, solar cell, etc.

<table>
<thead>
<tr>
<th></th>
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<th>Zennium pro</th>
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<td>±3.0A</td>
<td>±2.5A</td>
<td>±2.0A</td>
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<tr>
<td>Max parallel channels</td>
<td>17</td>
<td>5</td>
<td>5</td>
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</tbody>
</table>
THANK YOU VERY MUCH AND DO CONTACT US FOR YOUR OPTICAL SPECTROSCOPY AND SOLAR SIMULATOR NEEDS!

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