UNLEASH THE POWER AROUND US

Comprehensive Testing Solutions for Solar Panel Materials

PerkinElmer®
For the Better

See Our Range of Laboratory Instruments and Services

Solar Materials Analysis and Benefits

Free, clean, *renewable* – the power of the sun has the potential to serve millions of people around the world with limited or no access to electricity, while addressing some of our most daunting environmental challenges.

We understand that as the demand for solar power grows, manufacturers need to focus on key issues in the lifecycle of a solar cell – their efficiency, durability, and cost. The solar market consists of a huge diversity of industrial product manufacturers running many different processes – yet all facing similar challenges.

So it's no wonder solar manufacturers are turning to our solutions to help them. After all, with more than 80 years' experience in materials characterization, and with a vast portfolio of instrumentation and methods, we're the partner you can count on to keep the energy flowing.

Analytical solutions from PerkinElmer can help you:

- Achieve high product quality
- Reduce cell production costs
- Comply with ISO and ASTM standards
- Gain market competitiveness

WHITE PAPER: CHALLENGES AND TRENDS FOR EMERGING SOLAR CELL TECHNOLOGIES

This paper examines the industry and the UV/Vis/NIR, DSC, TGA, FTIR, and elemental analysis it relies on.

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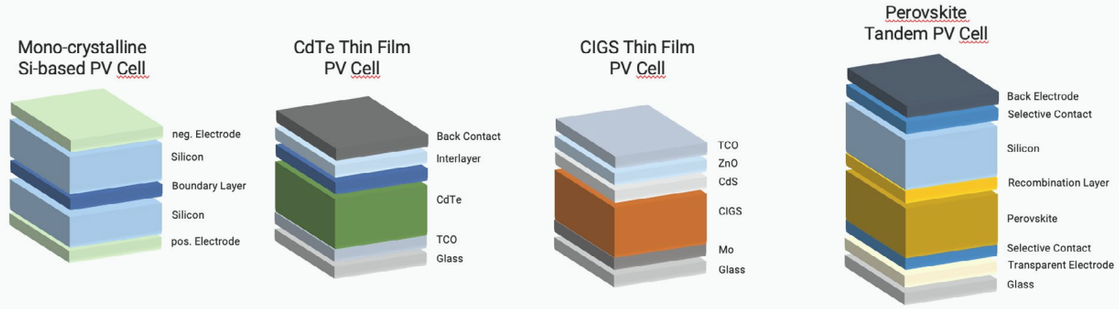
Solar Cell Types

At the heart of the PV panel is the solar cell, which converts sunlight directly into electrical energy. The solar panel's performance depends on the cell type:

Most Common Solar Cells



APPLICATION NOTE

This application note discusses how PerkinElmer DSC 4000 differential scanning calorimeter tests the heat flow curve of active layer materials in an organic solar cell, and the calculation of enthalpy of melting o determine the molecular alignment and compatibility of the material.

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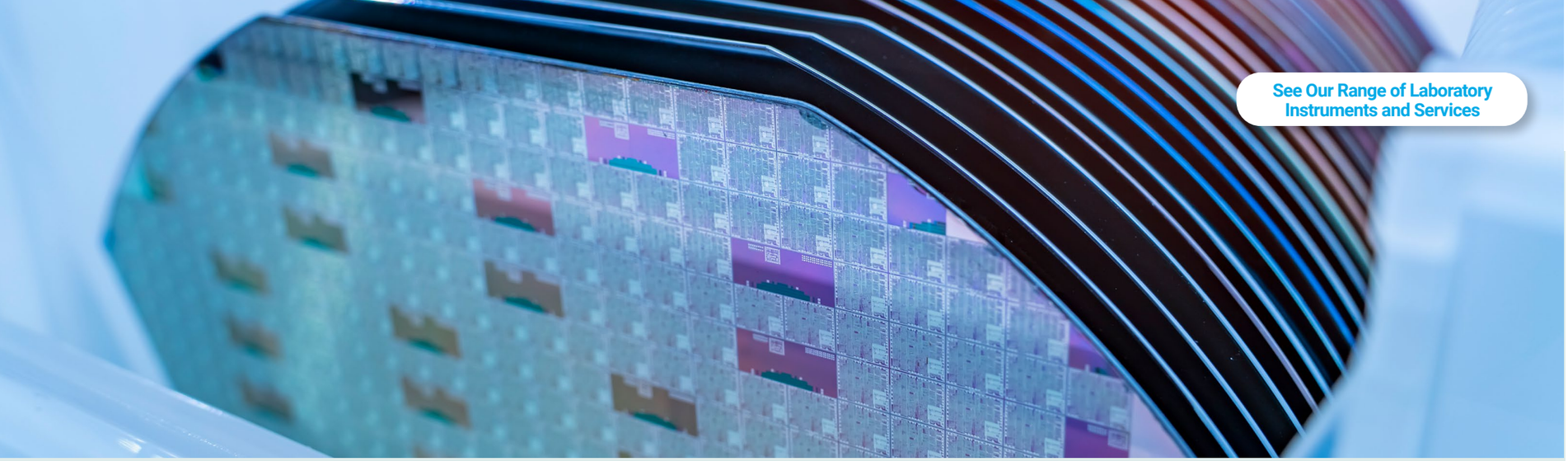

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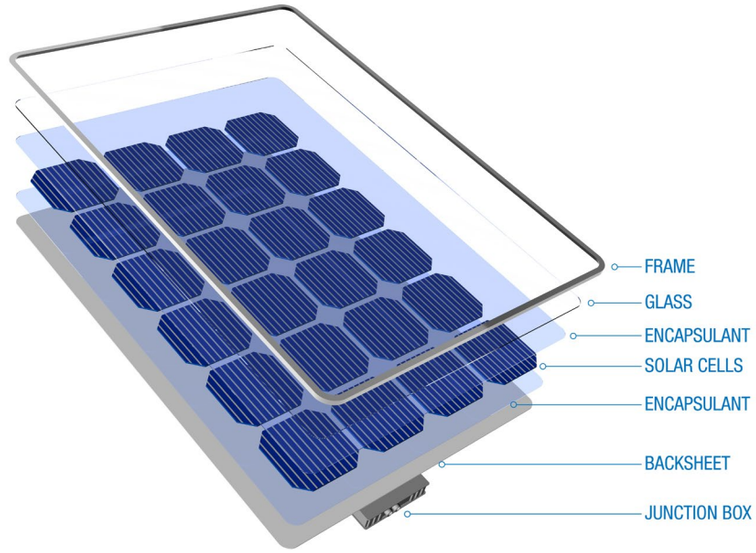
Analysis Overview In Each Panel Layer

We provide analytical solutions to help improve your production in each layer.

- **Frame:** Anodized aluminum – metallurgic analysis using ICP-OES and ICP-MS
- **Glass:** Tempered glass – optical analysis using UV/Vis/NIR
- **Encapsulant:** Polymer materials such as EVA - characterization using UV/Vis/NIR, DSC, Thermogravimetry and FTIR
- **PV Cells And Junction Box:** Silicon, metals, and battery active materials – multiple interconnected analysis using UV/Vis/NIR, DSC, TGA, FTIR, ICP-OES, and ICP-MS
- **Backsheet:** Polymer materials like PET – degradation and durability studies using UV/Vis/NIR, DSC, TGA, and FTIR

Solar photovoltaic panels made up of six main components:



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Advanced Analytical Solutions for Solar

The solar market consists of a huge diversity of industrial-product manufacturers running many different processes, yet still facing similar challenges. There's increasing pressure to achieve high product quality and reduce costs to stay one step ahead of the competition.

With our instruments and expertise, we can help you:

- Save money and ensure effective quality control
- Streamline your processes for outstanding operational efficiency
- Implement cost-effective solutions by reverse engineering

R&D
Improving cell efficiency and developing new materials

Supplier
Purity of, and impurities in, raw materials and process chemicals

Process
Efficient, process-oriented quality testing

Solar Cell
QA/QC of solar cell components and final solar cell; aging and defect analysis

Solar PV System
QA/QC of solar PV components

Typical Applications in the Solar Industry

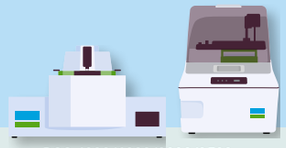
UV/Vis/NIR

- Optical characterization of glass, encapsulant, backsheet, and reflectors
- Measuring silicon wafers/cells
- Aging behavior
- Characterization of nanomaterials

LAMBDA 850+/1050+

DSC

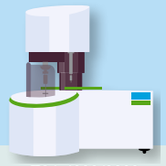
- Measurement of polymer encapsulants
- Analysis of battery active-layer materials
- Curing determination of EVA
- Study of epoxy materials
- Degree of crosslinking (DMA)
- Degradation studies of PET backsheet materials



DSC 4000/6000/8000/8500

TGA

- Characterization of polymers
- Adhesive characterization (TG-IR)
- Determination of EVA (TG-IR and TG-GC/MS)
- Characterization of novel TPO encapsulants
- Thermal degradation studies of PV encapsulants



TGA 4000/8000

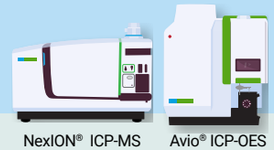
FTIR/FTIR Microscopy

- Development of advanced polymers (FTIR/NIR)
- Measurement of silicon wafers/cells at ambient/subambient temperatures
- Determination of infrared-optical properties of polymer films
- Raw material identification
- Impurity measurements

Spectrum Two™ Spotlight™ 400 FTIR

Elemental Analysis

- Silicon purity
- Purity/impurities of different materials
- Purity/impurities of chemicals used in manufacturing



NexION® ICP-MS Avio® ICP-OES

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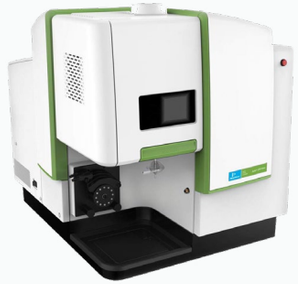
Aluminum Frame

The aluminum solar panel frame and mounting bracket are used to seal and fix solar battery components and provide stability and protection.

Inductively coupled plasma optical emission spectroscopy (ICP-OES) and differential scanning calorimetry (DSC) are two of the most important analyses for frame materials.



Avio® 220 Max hybrid simultaneous ICP-OES

Use ICP-OES to:

- Test aluminum-based alloy additives such as silicon, copper, zinc, and iron
- Analyze for impurities to ensure high-quality aluminum
- Measure aluminum purity
- Benefit from simple instrument operation with high-matrix samples
- Get excellent light throughput essential for low concentration measurements (optical design)
- Enable simultaneous background and analyte measurement

LEARN MORE ABOUT ICP-OES

Use HyperDSC to:

- Determine alloy cooling rates

LEARN MORE ABOUT HYPERDSC

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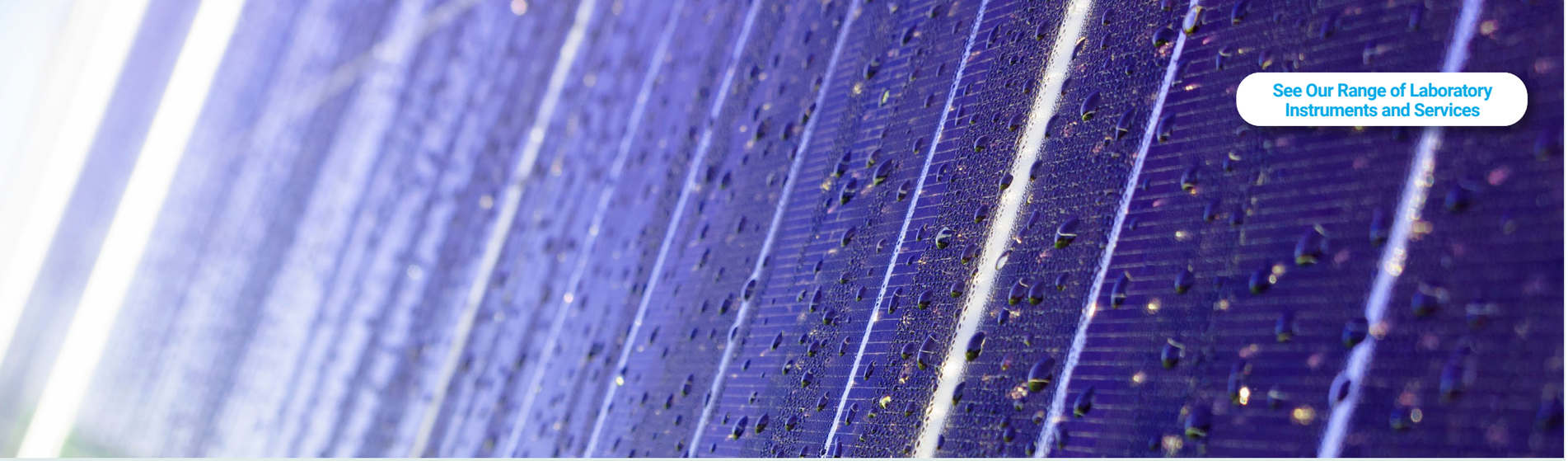

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Glass in Solar Panels

The panel glass used in solar photovoltaic cell components is highly transparent tempered glass with low iron content and an ultrawhite glossy or suede surface, from 2 mm to 4 mm thick.

Standard glass is often preferred, simply because it's inexpensive. It must deliver low reflectivity, high transmissivity, and strength, so a specialized glass may be required. For crystalline silicon solar panels, a 3.2-mm-thick piece of solar glass with a rough surface is used to facilitate adherence during EVA lamination.

GLASS BROCHURE

PerkinElmer solutions enable you to determine efficient energy storage and test glass and coating materials for the properties you need. Our long experience and in-house expertise mean we have solutions that align with the latest glass regulations (EN, ISO, and CIE); improve the flow of your lab; and increase your throughput and value to customers.

- Bidirectional reflectance distribution function (BRDF) and bidirectional transmittance distribution function (BTDF), other scattering measurements on diffusers, patterned and diffused coatings, and materials for straylight suppression
- Directional transmittance and reflectance properties on thin foils
- Directional reflectance properties on front surface mirrors
- Angular color measurements of samples and measurements of optical filters

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Coatings

The three most common types of coatings applied to solar glass are metal oxide (aluminum), silver nitrate, and gold chloride.

To reduce the reflection of sunlight, an antireflection treatment can be applied to a its surface by physical and chemical methods, making the glass surface fluffy and increasing the amount of light incident.

The high-performance LAMBDA™ 1050+ UV/Vis/NIR spectrophotometer is ideal for verifying the performance of these reflective components. The unique Universal Reflectance Accessory provides automated reflectance measurement at various angles, resulting in better sample characterization. Plus, by switching to the 150-mm integrating-sphere module, the total solar reflectance can be determined easily.

TECHNICAL NOTE

Learn about the accessory selection process for different specular/diffuse samples by measuring identical samples on three different reflection accessories.

LEARN MORE

LAMBDA 1050+ UV/Vis/NIR Spectrophotometer

- Versatile as able to handle widest range of sample types including glass and coatings
- Convenient to use with intelligent design features such as snap-in modules and large dual-sample compartments
- Fast scan rates and conveniently low set-up time
- Cooled InGaAs detector to extend spectral range up to 2500 nm
- Range of performance-improving accessories available

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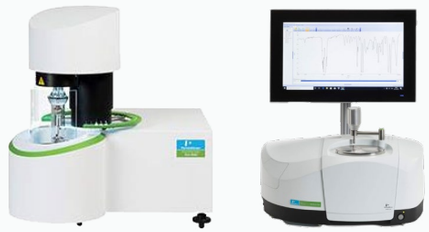
Encapsulation Materials

The polymer encapsulant makes a tight, permanent seal through crosslinking, which gives the encapsulant high optical transmittance; good adhesion, dielectric, and moisture-barrier properties; and mechanical compliance to accommodate system thermal stresses due to the different thermal expansion coefficients. So it's important to optimize the encapsulation process, including QA/QC of raw polymers and curing, weathering, and stability studies on different polymers.

Thermal analysis DSC, TGA and infrared spectroscopy are used to characterize the materials and study the curing process of different types of polymers.



TGA 8000™ thermogravimetric analyzer [left], Spectrum Two™ FTIR spectrometer with industrial-grade touchscreen and cloud connectivity for superior polymer analyses [right].

APPLICATION NOTE

Read about the characterization of degradation modes of ethylene-vinyl acetate encapsulants of photovoltaic modules by DSC

LEARN MORE

APPLICATION NOTE

Read about polymer identification using the Spectrum Two for mid-infrared polymer analysis

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Backsheet

The PV backsheet material you choose for your solar panel has a considerable impact on how it withstands the elements and performs over time. A reliable backsheet should be able to provide protection from moisture, physical damage, and UV rays, while also minimizing electrical discharge and thermal degradation.

Typical backsheet materials include; polyethylene terephthalate (PET), EVA, polyvinyl fluoride, polyvinilydene fluoride, and fluorethylene vinyl ether.

Analyses for degradation and durability of your polymer materials should be done using UV/Vis/NIR, FTIR, DSC, and TGA.

Easier Analysis with DSC
Here we show that DSC offers advantages over traditional GPC by providing a simpler and easier solution with comparable results.

APPLICATION NOTE

In this application note, the results obtained by GPC for molar mass of PET samples are compared to the crystallization temperatures of the same samples collected on a PerkinElmer DSC 4000.

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Accessories and Consumables

Get the Most Out of Your Instruments and Your Analysis

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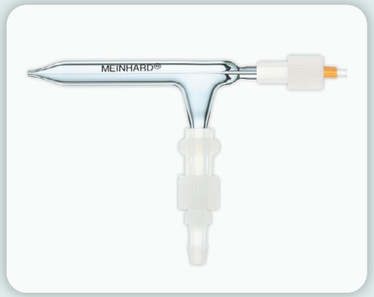
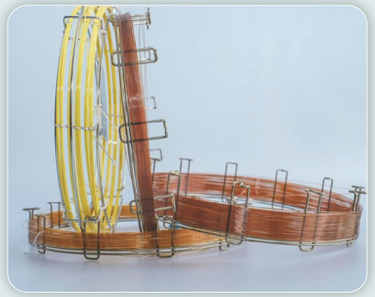
You invest great efforts into your research – and we do the same with our consumables and accessories, tested and validated to fit your lab's requirements. That's why we developed a full range of quality consumables and accessories suitable for a range of materials analytical applications. Below is a selection of the most commonly required parts.



Concentric Meinhard Nebulizers

Concentric Meinhard Nebulizers, GC Columns,SPEs, Graphite Tubes, LC Columns,AA Lamps, Torches, Syringes



GC Capillary Columns

Headspace Vials, Syringe, Liners, Septa, GC Capillary Columns

ICP Cones, Torches, Baffled Cyclonic Spray Chambers

ICP Torches

Thermal Analysis Sample Pans and Covers

These products offer reliable performance, help control operating costs, and maximize instrument uptime. Like our trusted instruments, our consumables and accessories offer the best performance, over and over. Click here to browse and shop.

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Complete Services for Increased Productivity and Efficiency

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Today's lab leaders are facing difficult challenges, from tighter deadlines to increased budget scrutiny to teams with various degrees of comfort with lab equipment. Time that could be spent getting ahead is utilized on noncore activities.

To help you overcome barriers to success, OneSource® Laboratory Services has built a team of trained scientists and engineers who bring their real-life knowledge to you, helping increase your productivity with recommendations on how to best utilize your assets. With this knowledge, you can get back to your core mission.

Labs of all sizes need to know their equipment will work as expected, every time they turn it on. From contracts and performance maintenance available for our instruments as well as other manufacturers' equipment to full lab asset management delivered globally, we can help you make the most of your important lab assets.

And for labs looking to introduce new equipment and techniques, we offer training at our facilities and at yours.

OneSource Services

- Asset optimization
- Lab environment and instrument monitoring
- Asset location
- Education and training
- Technology and descriptive analysis
- Internet of lab things/ lab of the future
- Remote support
- Multivendor services
- Compliance
- Lab support
- IT solutions
- Instrument qualifications

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Empowering Sustainability

By incorporating thoughtful action in each of these areas, we enable businesses like yours to successfully achieve sustainability objectives while minimizing the environmental impact.

Instruments and Solutions

Sustainability by Design:

- Meets sustainability requirements for new instruments, applications, and workflow solutions
- Minimizes waste and environmental impact while optimizing performance
- Reduces harmful solvents and gases.
- Increases instrument and component lifespans
- Incorporates energy-saving features and recyclable materials

Industry and Customer Focus

Enabling Sustainable Innovation:

- Uses next-generation, environmentally friendly materials
- Water reuse and recycling testing
- Analysis supports sustainable agriculture
- Workflows enable circular economy
- Analytics for battery development supports renewable energy and electric vehicles

Internal Operations

Sustainable Goals and Values:

- Reduces environmental impact
- Maximizes energy efficiency
- Reduces carbon emissions
- Decreases water, energy, and hazardous waste
- Positively impacts our environment, at work and in our communities

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For more information visit www.perkinelmer.com/category/solar

PerkinElmer, U.S. LLC.
710 Bridgeport Ave.
Shelton, CT 06484-4794 USA
www.perkinelmer.com

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