

DuPont™ Photovoltaic Encapsulants

Delivers long-term protection for the most sensitive portions of photovoltaic modules



Photovoltaic Application

Since the earliest days of photovoltaic manufacturing, DuPont™ Elvax® EVA resins have been tested and found to be ideal encapsulants. Converted into sheets and used to surround and protect silicon wafers and module circuitry, Elvax® resins are clear, soft, shock-absorbing, and able to deliver decades of service life.

Modules similar to the first ones ever encapsulated with Elvax® are still made today ... and the UL-recognized DuPont resin has been well documented and refined for this application. The resin is widely available everywhere; other uses include cushioning feet in walking shoes, sealing food packages and making hot melt adhesives.

In traditional rigid solar power modules, EVA resins remain widely preferred for making clear, soft, encapsulating sheets. DuPont remains the PV industry's leading supplier of EVA resins as encapsulants and our

latest special PV series of Elvax® EVA resins are helping build traditional and thin film solar modules around the world.

But traditional solar module technology is no longer seen as the only path to clean, affordable power generation from sunlight. DuPont science has been in the forefront of developing a new generation of encapsulants to help address the growing urgency and widening technology choices in solar power generation.

A new generation wants more

People now see energy choices impacting life on a shared and fragile planet. Society understands the need to reduce its environmental footprint, and the demand for scaled-up and more affordable solar power is here to stay.

DuPont is widely recognized for having reduced its own energy use since the early 90s. We strongly share the world's concern for energy sustainability, and enjoy seeing and responding to renewed enthusiasm for clean, affordable solar power.

And so, today, we're doing more than just help existing manufacturers gear up production of traditional modules. We're helping a new generation of engineers commercialize designs that better integrate solar power generation into building components, portable devices, and a reduced carbon footprint.

DuPont puts it together

DuPont is a leading materials and technology supplier to the PV industry, with more than 25 years of experience in PV materials development, applications know-how, manufacturing expertise and global market access.

DuPont Photovoltaic Solutions leverages science from across the company on a global scale to help support the dramatic growth in this industry, with a broad and growing portfolio of innovative materials that help manufacturers create solar modules that run more efficiently, last longer and make the use of sustainable energy a viable solution.

DuPont PV Encapsulants: Enabling Innovation

Encapsulants are among the most important materials to module manufacturers for high volume module sealing and integration. Choosing or creating the right material not only speeds module production, but can significantly prolong power generating efficiency and module durability.

The latest encapsulants from DuPont draw from two main sources of innovation: *technology transfer* and *tailored materials*. DuPont brings the full power of these forces to photovoltaic manufacturing, through a uniquely interdisciplinary PV encapsulants team. The team offers a potent capability for applied science and cross-fertilization of ideas, across a number of DuPont areas of excellence.

From the world of glass laminating ...

What sticks to glass? And to metal, and coatings, and plastic films, and framing? DuPont glass laminating products run up against all these elements and more ... including severe weather!

DuPont helped invent the world of laminated glass more than 70 years ago, with the creation of Butacite® PVB interlayers, still widely used to meet automotive glass needs and building safety codes. For thin film and flexible solar modules, **DuPont™ PV5200 Series** encapsulant sheets adopt Butacite® PVB technology to the needs of PV manufacturing.

About 10 years ago, DuPont Glass Laminating Solutions added the world's strongest architectural glass interlayer: DuPont™ SentryGlas®. Invented to help windows and doors survive hurricanes, the interlayer became a preferred structural glass component, helping span larger areas, reduce wind deflections, and meet building codes in thinner constructions.

Five times stronger and 100 times stiffer than PVB, **DuPont™ PV5300 Series** encapsulant sheets bring SentryGlas® ionomer-based performance to thin, weather-resistant photovoltaic encapsulation.

From the art of multilayer packaging ...

DuPont sees encapsulants playing an increasingly multi-functional role in next generation photovoltaic modules. Complex intersurface adhesion challenges, edge sealing, moisture resistance, impact protection, wavelength selectivity, structural support, thermal, dielectric and UV performance ... all these needs and more will be optimized in encapsulating films and sheets in the years ahead.

Imagine a clear, heat-sealable packaging film ... for example, around hot dogs ... a film just a few mils thick, yet containing as many as 11 different functionally specific layers of clear polymer. Some layers are there for structure, or barrier performance, or puncture resistance. Other layers just help tie things together. And all the layers have to process well, together, on high-speed equipment, anywhere.

DuPont packaging experts see thin, easy caulking, strongly adhesive films such as this manufactured on world-class coextrusion equipment every day. And these same experts now are also part of DuPont Photovoltaic Solutions, looking for encapsulant innovation opportunities through technology transfer.

And from DuPont tailored materials ...

Perhaps you need a polymer that's tougher, or more adhesive, or softer or harder, or has just the right melt flow. Tailored polymer blends, copolymers and modified polymers made possible by DuPont science are helping deliver increasingly specialized performance in applications ranging from flexible roofing membranes, to golf balls and bowling pins.

If you need a competitive edge in a new encapsulating resin or sheet, and you think we might be able to help at the molecular level, all it takes is a call.

We invite you to work with us

Lighter, portable, flexible, smart

Our experts and labs around the world are geared up for PV innovations and rapid growth. Perhaps you're thinking about a thin film or flexible module that can be popped open like a beach umbrella ... or integrated into a glass canopy or roof ... or installed at a remote well site to help pump clean water to a local home or village.

We think about such things, too, as we imagine with customers like you, how best to take advantage of next generation module technologies.

DuPont sees such innovations being highly dependent on new solutions in the area of encapsulating sheets and films. The work is underway already.

More durable and affordable

Innovations are also needed to make clean solar energy simply more affordable and reliable. Faster lines, lower processing costs, higher yields and longer-term power generation are among the needs being brought to DuPont by existing module makers. Relaxing with old, familiar encapsulating sheet technology won't keep today's manufacturers competitive.

Only DuPont lets customers explore such a wide array of encapsulant alternatives for improved cost effectiveness and accelerated application development.

DuPont's collected experience as a broad based supplier and innovator in photovoltaics, as well as in related industries such as safety glass, flexible packaging, and tailored polymers, makes us an ideal place to begin ...

... or begin again.

Contact Us Today

Encapsulant Guide for Photovoltaic Modules							
Cell Technology	Module Design	Encapsulant Requirements	Lamination Process	High Wind Load Application?	Weight Concerns?	Optimum Encapsulant	Benefit
Amorphous Silicon	Glass/Glass	Good moisture barrier Durable adhesion to glass and superstrate Protects cell from corrosion Minimum current leakage	Vacuum lamination	Yes	Yes	DuPont™ PV5300 Series	Durable adhesion to glass Superior wind load performance High strength allows for use of thinner glass or moving from tempered to annealed Excellent moisture barrier Potential for reducing or eliminating edge tape Potential to reduce edge delete area Fast lamination cycle Excellent electrical properties
				No	No	DuPont™ PV5200 Series	Durable adhesion to glass and metals in superstrate
			Autoclave	Yes	Yes	DuPont™ PV5300 Series	Durable adhesion to glass Superior wind load performance High strength allows for use of thinner glass or moving from tempered to annealed Excellent moisture barrier Potential for reducing or eliminating edge tape Potential to reduce edge delete area Excellent electrical properties
				No	No	DuPont™ PV5200 Series	Durable adhesion to glass and metals in superstrate
CdTe	Glass/Glass	Superior moisture barrier Durable adhesion to glass and superstrate Protects cell from corrosion Minimum current leak	Autoclave or Vacuum lamination	Yes or No	Yes or No	DuPont™ PV5300 Series	Durable adhesion to glass Superior wind load performance High strength allows for use of thinner glass or moving from tempered to annealed Excellent moisture barrier Potential for reducing or eliminating edge tape Potential to reduce edge delete area Superior wind performance Fast lamination cycle in vacuum laminator Excellent electrical properties
CIS/CIGS	Glass/Glass	Superior moisture barrier Protects cell from corrosion Adhesion to glass Minimum current leakage	Autoclave or Vacuum lamination	Yes or No	Yes or No	DuPont™ PV5300 Series	Durable adhesion to Glass Excellent moisture barrier Potential to use less or remove edge tape Potential to reduce edge delete area Superior wind performance Fast lamination cycle in vacuum laminator Excellent electrical properties
Crystalline Silicon	Glass/Flexible Backsheet	High light transmission for front encapsulant Low modulus Protects cell from corrosion Adhesion to front glass and cell Adhesion to back sheet and cell	Vacuum lamination	NA	NA	DuPont™ PV1000 Series	Highest light transmission Soft polymer- lower risk of cell breakage during lamination Durable adhesion
Crystalline Silicon	Glass/Glass	High light transmission for front encapsulant Low modulus Protects cell from corrosion Durable adhesion to glass and to cell	Vacuum lamination	Yes	Yes	DuPont™ PV5300 Series	Superior Wind Performance Fast lamination Cycle Excellent electrical properties
				No	No	DuPont™ PV1000 Series	Highest light transmission Fast lamination Cycle Soft film
			Autoclave	Yes	Yes	DuPont™ PV5300 Series	Superior Wind Performance Excellent electrical properties
				No	No	DuPont™ PV1000 Series	Provides durable adhesion Highest light transmission

For more information about Encapsulants or other DuPont Photovoltaic Solutions:
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The miracles of science™