



NEW PRODUCT ANNOUNCEMENT:

NANOPTTEK SHG300 HYBRID SOLAR HYDROGEN GENERATOR™

Produce Up To 3X More Hydrogen per KWh of Input for On-Site Chemical and Industrial Manufacturing, Electrical Energy Storage, Hydrogen Vehicle Refueling

The Nanoptek SHG300 is a hydrogen generator panel that uses sunlight and Nanoptek's patented engineered band-gap photocatalyst to reduce the electrical power needed to split hydrogen from water to as little as 1/3 of that required by PEM or 1/2 of alkaline electrolyzers, for an electrolysis efficiency of 103% to as much as 148% on an electrical-energy basis.*

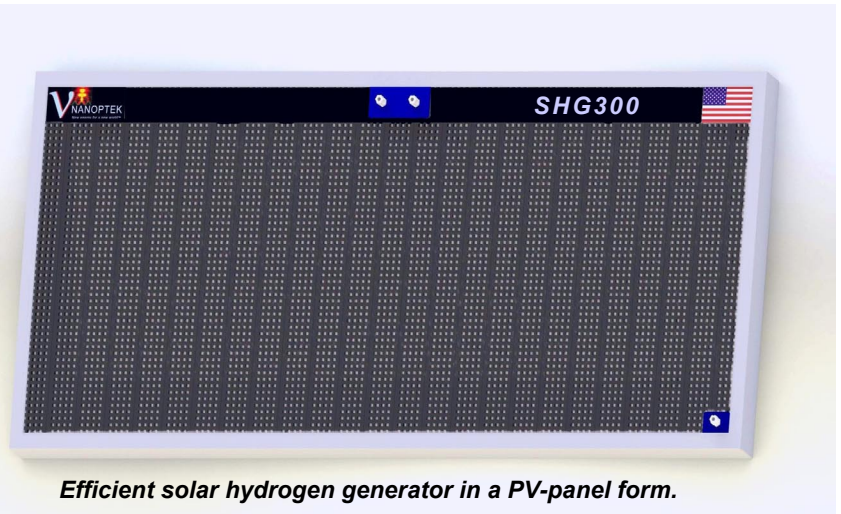
Install the SHG300 panels for on-site hydrogen feedstock supply for chemical manufacturing, or industrial processes such as semiconductor or glass manufacture. The SHG300 can also enable efficient electrical energy storage (EES) for utility peak-shaving, remote telecomm back-up, or buffering of intermittent renewable power. Together with photovoltaic (PV) or wind power, the SHG300 panels can produce hydrogen even in remote off-grid off-pipeline areas, or supply refueling stations for hydrogen vehicles, all without any carbon by-product.

When the sun is not shining, the SHG300 can use grid or non-solar renewables such as wind to continue to produce hydrogen with its hybrid integral MMO (mixed metal oxide) titanium anode with conversion efficiency equal to that of many PEM electrolyzers, for 24/7 operation, stable hydrogen supply, and excellent return on investment.

While of course no carbon is produced with renewable power input, the efficiency of the sunlit SHG300 panels reduces even the carbon from fossil-fueled grid power input 50% to 66% per unit of hydrogen produced compared to alkaline and PEM electrolyzers respectively.

The SHG300's highly efficient use of the shorter ultraviolet (UV) and blue wavelengths in sunlight means that it can continue to generate hydrogen at up to 1/3 or more of its peak capacity on most overcast days, because these energetic wavelengths penetrate cloud cover more effectively than the rest of sunlight.

The modular 2.0m² panel form-factor is easily interconnected to scale from commercial roof-top to multi-acre field installations, or down to even a single unit for off-grid backup. It stacks flat for economical warehousing and shipping. Optimum shallow-angle mounting means the panels can be packed more densely in fields or on roofs.



Efficient solar hydrogen generator in a PV-panel form.

SHG300: Up to 3X More H₂ per KWh In

Based on higher heating value (HHV): 39.4 kWh/kg of H₂

	H ₂ Generator	KWh to H ₂ Conversion Efficiency*	H ₂ Produced (Flow Rate)	H ₂ per KWh Yield Gain
100 KWh IN	PEM Electrolyzer	52%	1.3 kg (300 sccm)	—
	Nanoptek SHG300	103% (MMO + TiO ₂)	2.5 kg (300 sccm)	2X
	Nanoptek SHG300	148% (TiO ₂ only)	3.8 kg (150 sccm)	3X

Key Benefits:

- Hybrid design operates 24/7
- 2X to 3X more H₂ produced per kWh in
- No carbon by-product in all-solar or renewable-to-MMO modes
- Up to 1/3 of peak capacity on cloudy days
- Lower capital cost than electrolyzers of equal H₂ production rate
- Almost no operating cost in all-solar mode
- Minimal maintenance
- Impurities: Easily removed O₂ and H₂O
- Silent operation
- Use of diffuse light eliminates need to track
- Rapid start-up, steady flow in about 10 min.

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Acre Installation SHG300 75% Packing Density 24/7 Operation Boston, MA 820 W/m ² direct solar (Thorlabs S302C)	Electrical Energy Consumed Producing KG of H ₂	Electrolysis Electrical Efficiency (HHV) <u>39.4kWh/kg_{H2}</u> kWh _{in} /kg _{H2}	DC Volts at Anode	H ₂ Produced Per Acre Per Hour (HHV)	Annual H ₂ Produced Per Acre
TiO ₂ Photo-Anode Only	26.7 kWh	148%	1.0V	1.25 kg	10,950 kg
TiO ₂ and MMO Anodes	38.3 kWh	103%	1.0V / 2.3V	2.5 kg	21,790 kg
MMO Anode Only	67.9 kWh	58%	2.6V		

SHG300 Panel Physical	Weight (empty)	Weight (filled)	Weight/area (filled)	Height	Width	Thickness (includes insulation)	Electrolyte Volume	Solar Collection Area
English	113 lbs	154 lbs	6.1 lbs/ft ²	43 in.	85 in.	2.5 in	4.5 gal.	21 ft ²
Metric	51.4 kgs	70.0 kgs	29.7 kgs/m ²	1 m nom.	2 m nom.	6.4 cm	17 liters	2.0 m ²

Safety and Environmental Features:

- Reduces/eliminates carbon from H₂ production
- Leak-resistant solvent-welded acrylic chamber
- Dual-sealed Ti and SS electrode pass-throughs
- Potassium carbonate (potash) electrolyte (pH<12) is safer than KOH
- Auto-shutoff valves for leak-free disconnection
- Safety shut-off switch
- Low-pressure, low temperature operation
- Non-asbestos gas separation barrier
- Recyclable and/or low energy materials
- No exhaust plume
- Higher tolerance of water feed quality than most electrolyzers; water need not be distilled

Design Highlights:

- Nanoptek patented shifted-bandgap UV-Blue™ titania (TiO₂) photoanode
- MMO (Mixed Metal Oxide) auxiliary anode
- 316 stainless steel cathode
- High transmission S-UVT acrylic™ window
- Rugged acrylic body
- 6063-T5 Al frame, anodized and acrylic overcoated
- High packing density for field and roof installations
- Flat stacking for economical shipping
- Passive auto-fill
- Thermal signature less than 35°C above ambient
- Minimum temperature: -7°C operating, -40°C storage

- Each kWh in produces 2X to 3X more hydrogen than electrolyzers during sunny hours •
- Hydrogen feedstock for chemical manufacturing, even in off-grid off-pipeline areas •
- On-site Hydrogen for industrial use: 2 acre installation supplies a glass furnace •
 - Supply hydrogen refueling stations for hydrogen cars •
 - Also produces oxygen (8X weight of hydrogen) for multiple industrial uses •
- Electrical energy storage (EES): Buffer renewables, Peak-shave, Telecomm back-up •



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Now accepting pre-orders for limited production beginning Q1, 2012

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