apjet INC.

PLASMA TECHNOLOGIES

High Energy Innovation™

APCure™ GreenFIX™-GDL

PLASMA-COATING PROCESS FOR WATERPROOFING GAS DIFFUSION LAYERS

- Cost Savings of $7.50 per square meter
- Capital payback in less than 4 months
- 7X production capacity

APCure™ GreenFIX™-GDL

PLASMA-CURED WATERPROOF GAS DIFFUSION LAYER COATING

INVISIBLE WATERPROOF COATING PROCESS FOR GAS DIFFUSION LAYERS

APJeT combines their APCure™ Plasma Machinery for Chemical-curing and GreenFIX™-GDL Chemistry to waterproof GDLs (Gas Diffusion Layers) at room temperature and rapid line speeds.

FINANCIALS

	PTFE Sintering	APCure Plasma	
Output	202,000 m2/yr	1,440,000 m2/yr	700% More
Process	$9.54 /m^2	$2.00 /m^2	4.8X Reduction
Capital	$2M	$475k	76% Decrease

1.5M
Savings per year

4 mo
Payback in months

7X
Production capability

REFERENCES

PTFE Sintering output based on 1m substrate width, 1-2m/min process speed, 8hr/day, 300days/yr
APCure Plasma output based on 1m substrate width, 10m/min process speed, 8hr/day, 300ays/yr

PTFE Sintering Process Costs determined from USA Department of Transportation:
https://www.energy.gov/sites/prod/files/2017/06/f34/fcto_sa_2016_pemfc_transportation_cost_analysis.pdf
Costs include hydrophobic paper coating and sintering costs with global inflation
Based on 200,000m^2/yr output

Savings and payback based on 200,000m^2/yr output

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INVISIBLE WATERPROOF COATING PROCESS FOR GAS DIFFUSION LAYERS

GreenFIX™-GDL Chemical Coating

- Ultra-thin, highly waterproof coating replacement for PTFE
- Up to 99% less fluorine than traditional PTFE coatings
- Encapsulates individual fibers, maintaining high air permeability
- Maintains the high conductivity of the base material
- No impact on substrate flexibility
- Solvent-free chemical formulation

APCure™ Plasma Machinery for Chemical-Curing

- Cures GreenFIX™ chemistry at room temperature and pressure
- Compact, roll-to-roll machinery
- Line speeds up to 10 mpm
- Handles roll widths up to 2 meters
- 79% reduction in cost over conventional processing

THE FUTURE OF WATERPROOF COATING

APJeT Plasma Technologies has revolutionized the PTFE coating process with their next generation GreenFIX™-GDL waterproof coating and APCure™ plasma chemical-curing technology. GreenFIX™ chemistries are exclusively compatible with APCure™ machinery and form an ultra-thin, conformal coating around the fibers, leaving pores open. The final waterproof coating repels as well as traditional PTFE with up to 99% less fluorine and minimal impact on key properties including air permeability, conductivity, and substrate flexibility.

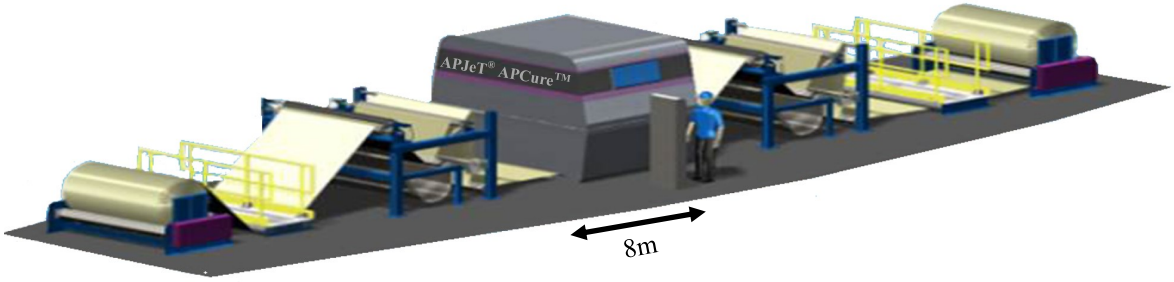
The secret to APJeT's futuristic coating process is their patented plasma chemical-curing technology, APCure™ machinery. APCure™ machinery uses plasma, the fourth state of matter, to instantly cure APJeT's proprietary chemistries at room temperature and pressure. Without the need for heat, line speeds can be increased dramatically and operating costs reduced by 79%.

REDUCE FLUORINE

Fluorine concentration can be drastically reduced, up to 99%, without sacrificing waterproof performance with APJeT's APCure™ Plasma Machinery and GreenFIX™-GDL chemistry.

*GLI Procedure E9-3 to determine the elemental fluorine content

*94% Less Fluorine		*96% Less Fluorine		*99% Less Fluorine	
GreenFIX™-GDL (on P75 paper)	**GDS2120** (MPL+PTFE)	**GreenFIX™-GDL** (on TGPH060	**TGPH060** (MPL+PTFE)	**GreenFIX™-GDL** (on W0S01011)	**W1S1011** (PTFE+MPL)
AvCarb P75 Paper		Toray TGPH60 Paper		CeTech Carbon Cloth	



The APJeT APCure™ system can handle web goods up to 2 meters in width and runs at line speeds of 10mpm.

The machinery fits easily into existing facilities and process lines, with a typical length of only 8 meters.

APCure™ GreenFIX™-GDL

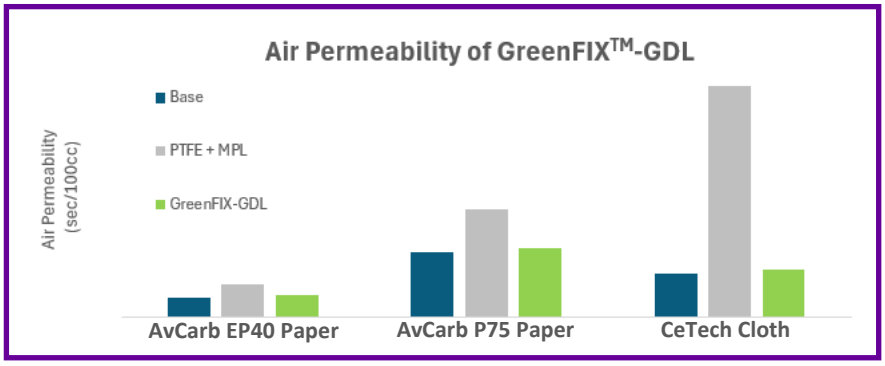
PLASMA-CURED WATERPROOF GAS DIFFUSION LAYER COATING

Performance Data

IMPROVE GAS PERMEABILITY

APJeT's revolutionary GreenFIX™-GDL coating maintains a gas permeability similar to the base material while still providing a high degree of waterproof performance.

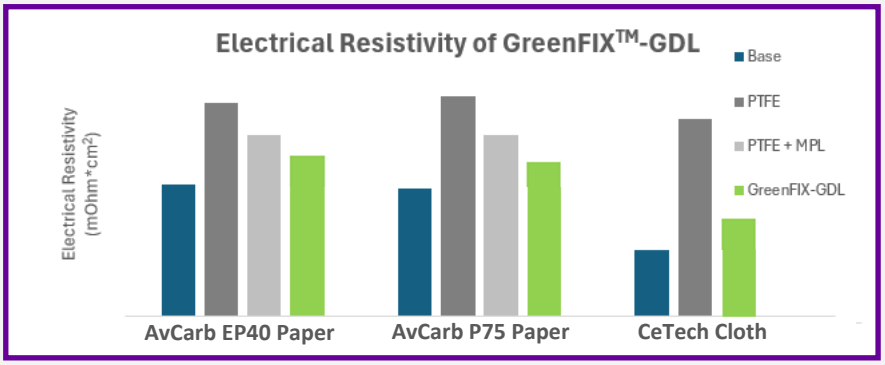
The waterproof coating encapsulates the fibers leaving the existing pores unclogged and available for maximum gas and water transport.



REDUCE RESISTIVITY

APJeT's GreenFIX™-GDL coating eliminates the conductive losses expected with a traditional waterproof coating. The final waterproof GDL substrate maintains a high degree of conductivity without any need for MPL.

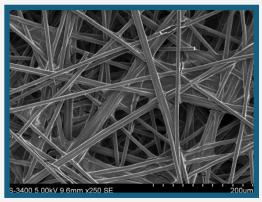
These improvements in conductivity enable the use of a thinner starting carbon material, allowing for more GDLs per unit area and a higher efficiency fuel cell.



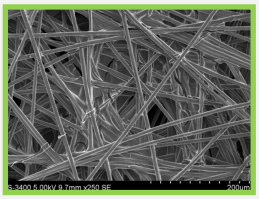
CONFORMAL COATING

The secret to APJeT's performance benefits is the creation of a conformal coating that encapsulates fibers rather than clogging pores, providing full waterproof performance without impacting porosity.

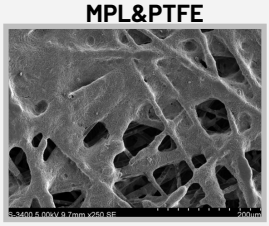
Toray TGPH060 Paper Base



Base + GreenFIX-GDL



Base + Conventional MPL&PTFE



CeTech Cloth Base

Base + GreenFIX-GDL

Base + Conventional MPL&PTFE

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