



A Battery Revolution

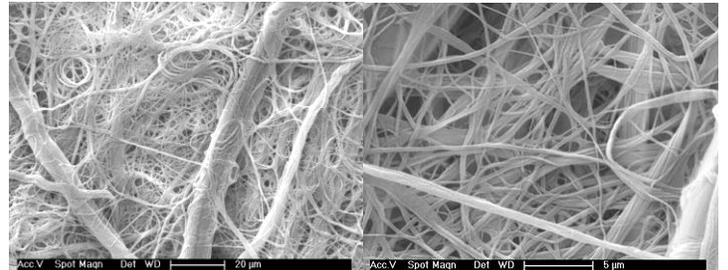
DreamWeaver nonwoven nanofiber battery separators, made from a blend of nanofibers and microfibers, provide:

- **Improved Safety:** Stability over 190 C enables batteries with improved safety compared with thermoplastic separators that melt and shrink at low temperatures.
- **Higher Power:** Higher ionic conductivity results in greater electrode utilization at high C-rates, thereby improving the available power in electric vehicles, power tools and other high performance applications.
- **Higher Energy Density:** More efficient ion transfer allows for flexible battery design with thicker electrodes and reduced separator area, increasing energy density.

Due to these attributes our DreamWeaver Silver separator allows for **thinner, lighter and smaller** batteries. In addition **cost reductions** result from less expensive **separator and battery manufacturing costs**.

Nanofibers and Microfibers

Dreamweaver's patented technology is based on a combination of microfibers and nanofibers. The microfibers provide scaffolding with high strength and an open structure, as can be seen in the SEMs below. The nanofibers drape over the microfibers so the average pore size is low, and the pore size distribution is narrow.

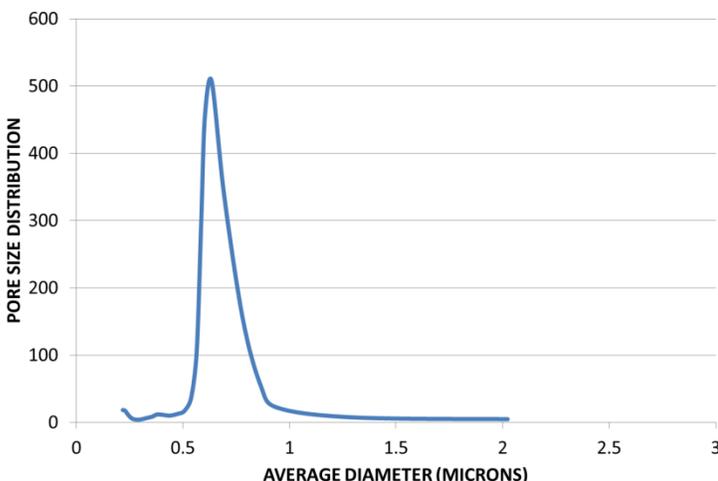


Microfibers: Microfibers by themselves leave a pore size of at least several microns, much too large to be used in lithium ion battery separators.

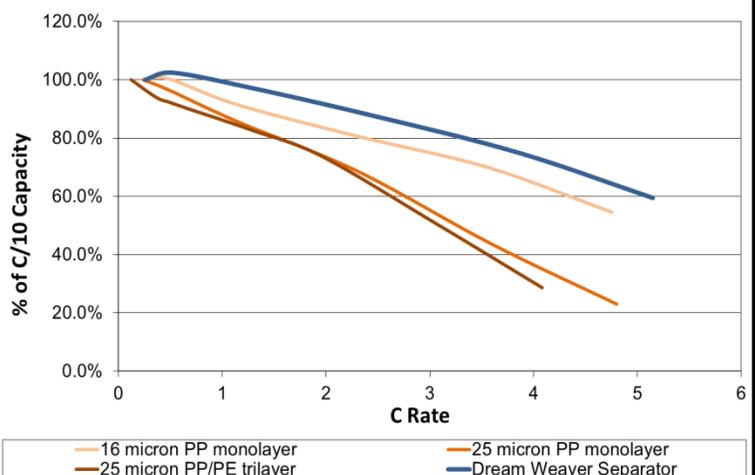
Nanofibers: Nanofibers by themselves tend to blind and have high resistance to the flow of liquids or ions. They also make extraordinarily weak webs, without the strength required in a high speed battery manufacturing process.

Combined: Combined, the strength and openness of the microfiber scaffolding is attained, while Dreamweaver's proprietary processing ensures that the nanofibers drape over the microfibers strategically, closing down the pore size while maintaining a high permeability to ions

PORE SIZE DISTRIBUTION VS AVERAGE DIAMETER



Rate Capability Comparison of Four Separators



PRODUCT INFORMATION

Name

Dreamweaver Silver™

Description

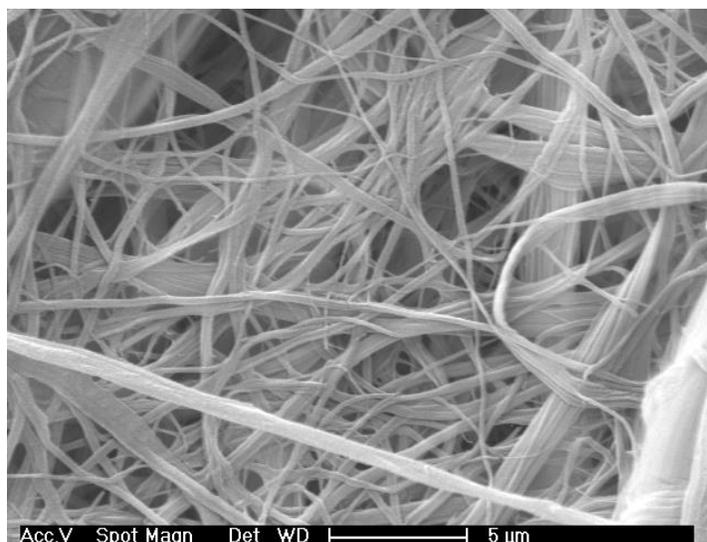
20, 25 μm and 40 μm Nanofiber Membrane

Primary Application

Primary and Secondary Lithium Batteries

Product Features

- High porosity in a uniform, stable sheet
- Good chemical resistance
- Uniform pore structure with narrow pore size distribution
- Excellent wettability; materials wet in just seconds, reducing processing time and increasing uniformity
- Thermally stable above 190C; materials do not melt or shrink, reducing shrinkage induced shorts
- Low electrical impedance and high porosity provide high rate capabilities
- Physical properties closely matched to foil current collectors



Technical Features (Typical Properties)

Basic Membrane Property	Unit of Measure	USABC Requirements	Dreamweaver Silver™ 25	Dreamweaver Silver™ 40
Thickness (12.6 psi)	μm	<25	27	36
Thickness (25 psi)	μm	<25	26	34
Gurley (JIS)	seconds		80	80
Porosity	%		56%	60%
Pore Size	μm	<1.0	1.1	0.4
TD Shrinkage @ 160 C	%		0	0
MD Shrinkage @ 160 C	%		2	2
TD Strength	Kgf/cm ²		175	105
MD Strength	Kgf/cm ²	>70	330	225
Young's Modulus	Kgf/cm ²	>5,000	23,000	14,000
Melt Integrity	C	>200	300	300
Puncture Strength	g	>300	280	250
Moisture Content	%	<0.0005	3.7%	2.9%

Materials may contain up to 4% moisture. Please dry thoroughly before testing; we suggest 140 C for 1 hour for hand sheets and 24 hours for rolls. Due to higher porosity, additional electrolyte may be required. Low electrolyte content may cause high resistivity or shorting.

Packaging

- Samples are available as 8.5 x 11 inch sheets, or on rolls cut to requested width.
- Production packaging available on rolls of length 400m – 1200 m.

Contact Information

2 Parkway Commons Way, Greer, SC 29650

864-968-3320

Laura.Bruce@Dreamweaverintl.com