PolyCharge America, Inc.

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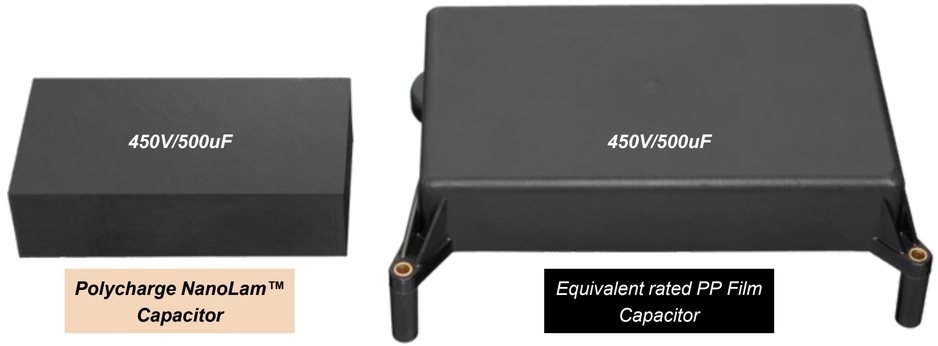
PolyCharge NanoLam™ Capacitors…



Polycharge NanoLam™ Capacitor

Equivalent rated PP Film Capacitor

SIGNIFICANTLY REDUCED VOLUME AND WEIGHT [> 2x Energy Density]

Sub-micron NanoLam™ thin film dielectrics means higher energy density when compared to polypropylene film capacitors.

140ºC + *105ºC*

Polycharge NanoLam™ Capacitor

Polypropylene Film Capacitor

HIGHER OPERATING TEMPERATURES.

Radiation curable dielectric materials formulated for high temperature handling capabilities (and self-healing). Ideal for higher frequency and higher current applications.

… And COST Competitive

CONVENTIONAL TECHNOLOGY…

Polypropylene (PP) film is extruded, metallized, wound, processed, and packaged to create a finished capacitor.

- Quality extruded films produced by a small number of producers. Films are sold to capacitor manufacturers and 3rd-party metallizers.
- 2.2µm film is thinnest currently available. Thinner film = higher cost to produce.
- Polypropylene film currently represents the best combination of performance and price; however, achieving thinner films is problematic AND intrinsic operating temperatures limited (Max. 105°C).
- Metallized films are wound into capacitor "bobbins," processed, and packaged to create the finished capacitor.

Example PP Film Extrusion Line.

Example Metallizer

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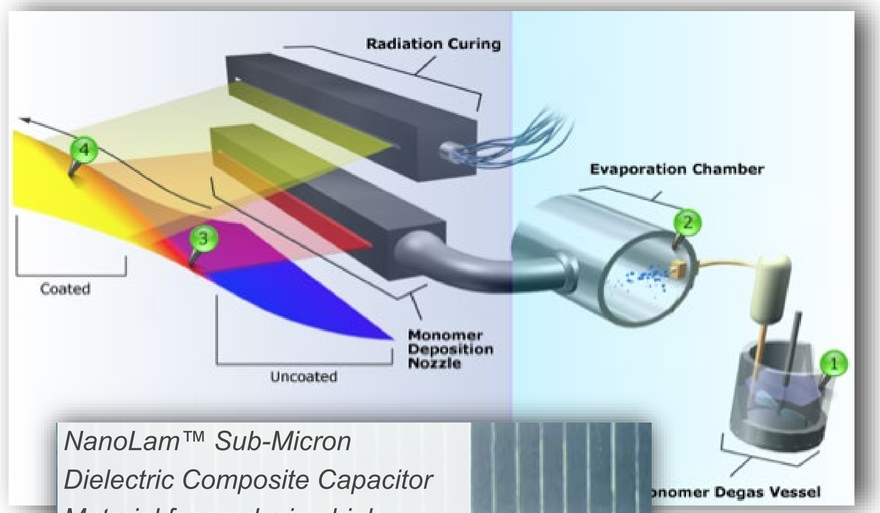
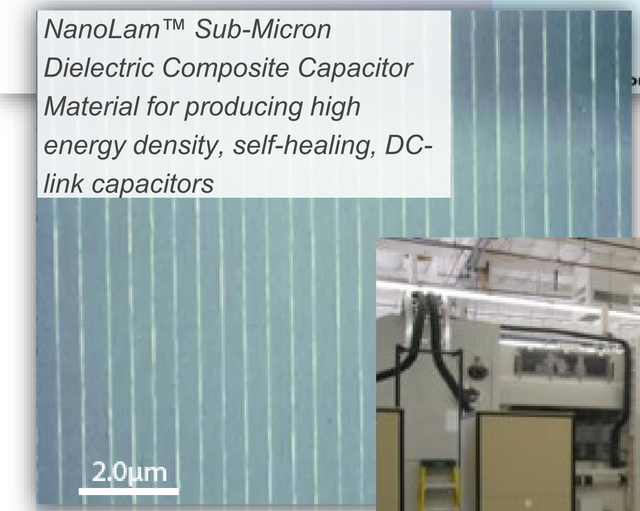
Polycharge Nanolam™ Capacitor Fabrication

Thin film dielectric formation and electrode deposition combined in a single process step

- ELIMINATES THE FILM PRODUCER. Dielectric formation and metallization occur in a SINGLE PROCESS STEP reducing overall product cost.
- SUB-MICRON DIELECTRICS. Vapor deposited dielectrics ranging in thickness from 300 to 850 nanometers.
- HIGH TEMPERATURE DIELECTRICS. Thermoset (not thermoplastic, like PP) acrylic dielectrics capable of in-service temperatures in excess of 140°C (compared to 105°C for PP)
- PRISMATIC FORM FACTOR. For greater volumetric efficiency and lower inductance.
- COST COMPETITIVE. Fewer process steps. Low-cost materials. Supply chain flexibility.





NanoLam™ Sub-Micron Dielectric Composite Capacitor Material for producing high energy density, self-healing, DC-link capacitors

1-Machine for Dielectric Formation + Metallization

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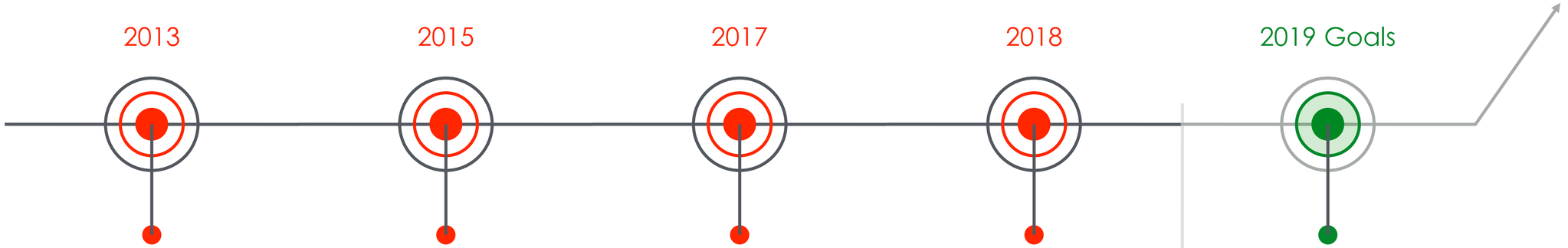
Polycharge NanoLam™ Dielectrics Compared to Other Polymers

	NanoLam™ Thermoset Dielectric	Polypropylene (PP)	Polyester (PET)	Polyethylene-napthalate (PEN)	Polyphenylene-sulfide (PPS)	Teflon (PTFE)
Dieletric Constant (K)	**3.2**	2.2	3.3	3.2	3	2.1
Voltage Breakdown (V/µm)	**> 1000**	650	575	550	550	275
Dissipation Factor (%)	**< 1.0**	< 0.1	< 1.5	< 1.0	< 0.2	< 1.0
Max. Operating Temperature (ºC)	**140**	105	125	125	200	200
Self Healing	**Very Good**	Very Good	Good	Poor	Poor	Very Good
Glass Transition Temperature (ºC)	**> 200**	0	70	120	85	110
Dielectric Thickness (µm)	**0.40 - 1.00**	> 2	> 1	> 1	> 2	> 2
Plastic Type	**THERMOSET**	Thermoplastic	Thermoplastic	Thermoplastic	Thermoplastic	Thermoplastic

Polycharge Achievements and 2019 Goals



2013

Awarded $3.5 million grant from the U.S. Department of Energy to develop technology for automotive applications.

2015

Successful demonstration of high voltage, high capacitance, part suitable for automotive applications.

2017

Orders placed for first production line to be located in Tucson, AZ.

Limited Distribution and License Agreement with APAQ for China Expansion.

2018

Formation of Polycharge America..

Design Validation (DV) for two inverter programs

Complete second season of deliveries to for Formula-E race circuit.

2019 Goals

Q2 - Commissioning of first production line in Tucson, AZ.

ISO 9001-2015 and IATF 16.949 Certification

AECQ200 and ZVEI Certification

Win first automotive order for 2022 Start-of-Production (SOP)

Introduce product line for distribution (non-automotive applications)

Active programs with T1 suppliers and OEM's with potential revenue of > $2.2 billion

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Linking energy and motion