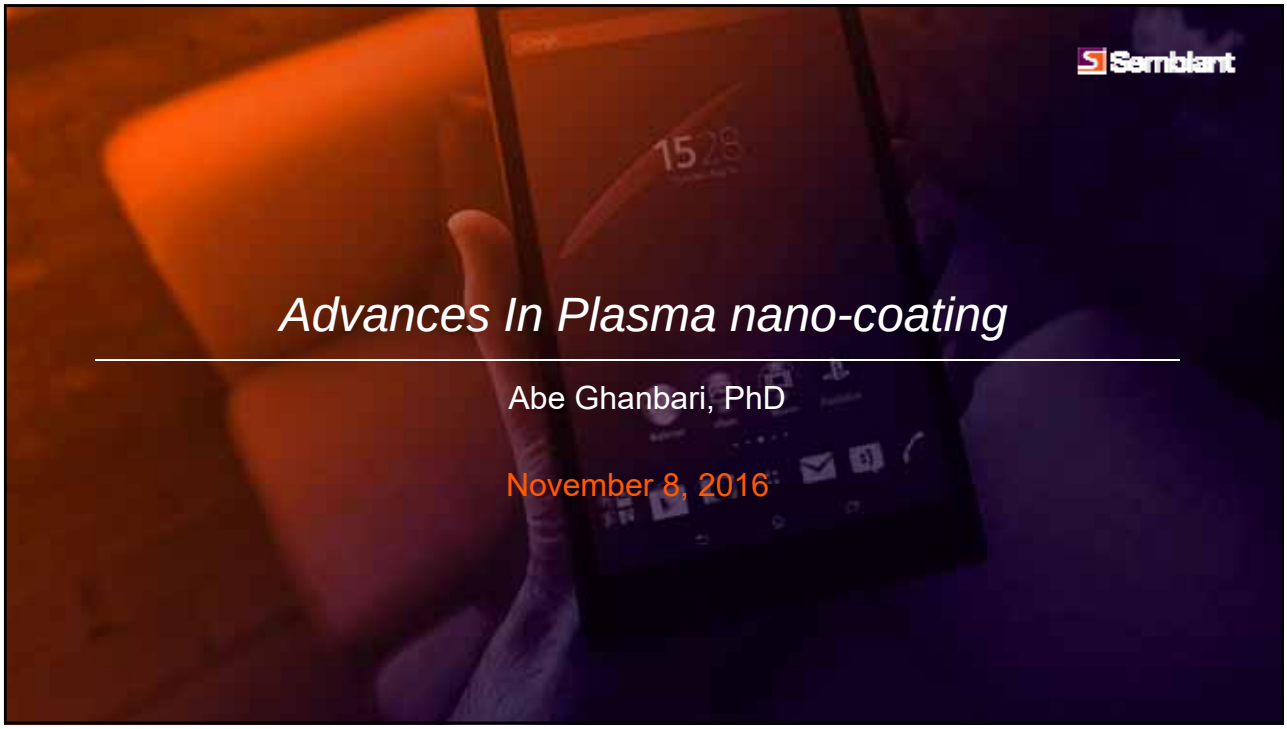


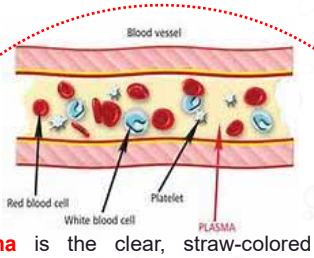
Overview

- Plasma Definition
- Plasma Characteristics
- Plasma Processing Applications
- Semblant Plasma Nano-coating Technology
- Semblant Plasma Nano-coating Properties
- Semblant Turnkey High Volume Manufacturing Capabilities
- Semblant Market Served
- Who We are
- Concluding Remarks

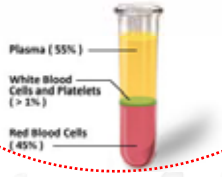
A tale of two different universes

Plasma an ionized gas consisting of positive ions and free electrons in proportions resulting in more or less no overall electric charge, typically at low pressures (as in the upper atmosphere and in fluorescent lamps) or at very high temperatures (as in stars and nuclear fusion reactors).

≠

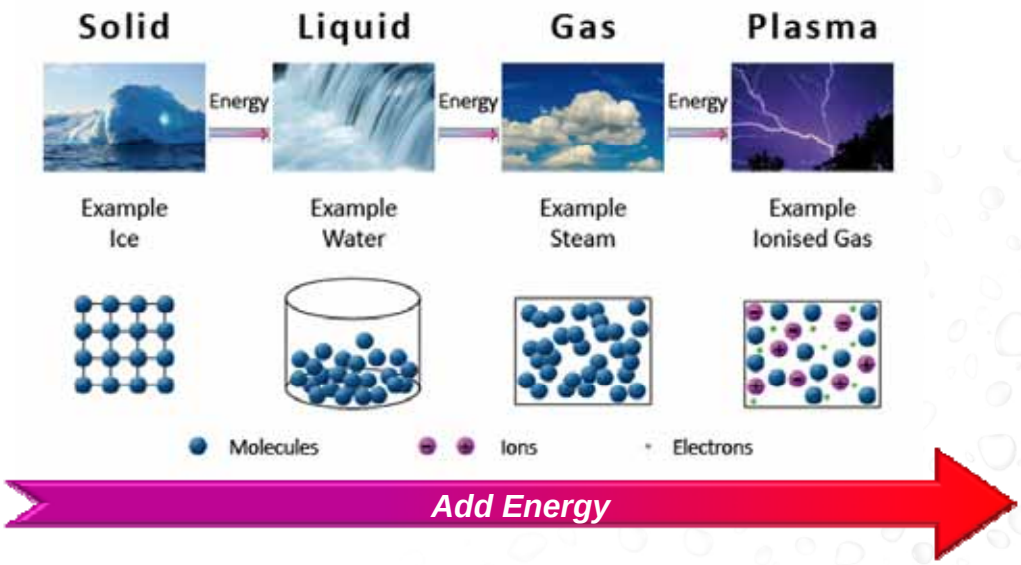


Plasma is the clear, straw-colored liquid portion of blood that remains after red blood cells, white blood cells, platelets and other cellular components are removed



Slambient 3

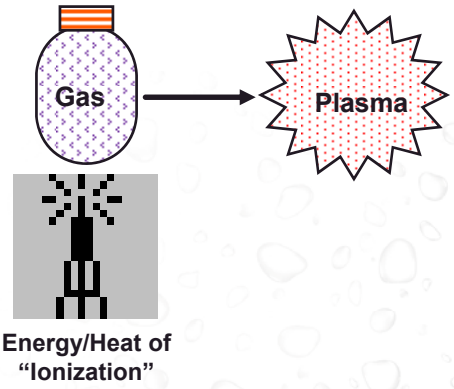
State of Matter



Slambient 4

Plasma Generation

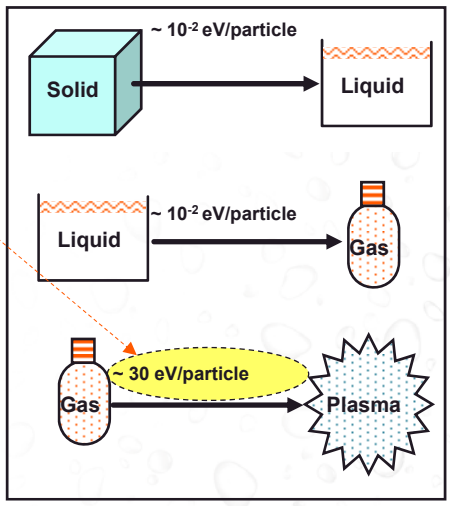
- **IONIZATION**
  - For a gas to be able to conduct electricity, its constituents has to be "broken-down" into ionized species. It is this ionized species that is frequently referred to as ***plasma.***
- **METHODS**
  - Electron Impact
  - Electric Field
  - Thermal (high pressure arcs)
  - Chemi-ionization (flame)



Semblant 5

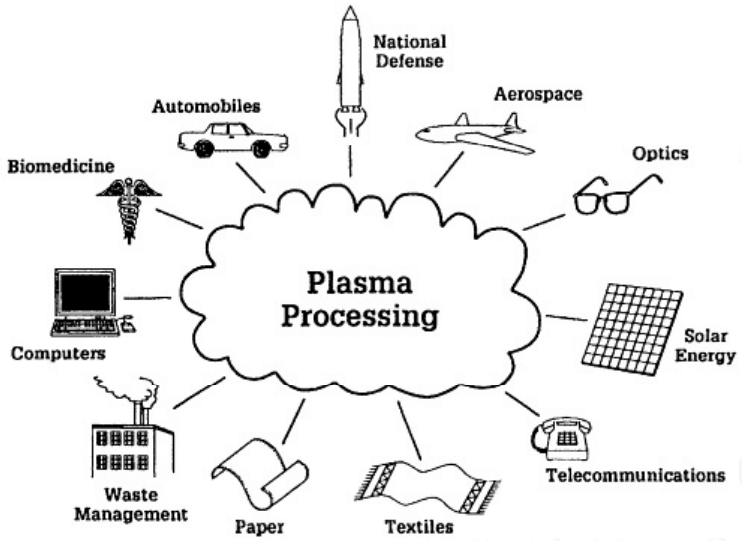
Plasma Properties

- 99% of the matter in the universe is composed of plasma.
- Plasma is a good electrical conductor.
- Plasma is the most energetic state of matter
- Industrial plasmas lack thermal equilibrium between ionized components.
  - T_e ~ 1 - 10 eV
  - T_i ~ 0.04 eV
  - T_0 ~ 0.03 eV



Semblant 6

Plasma processing applications



Semblant 7

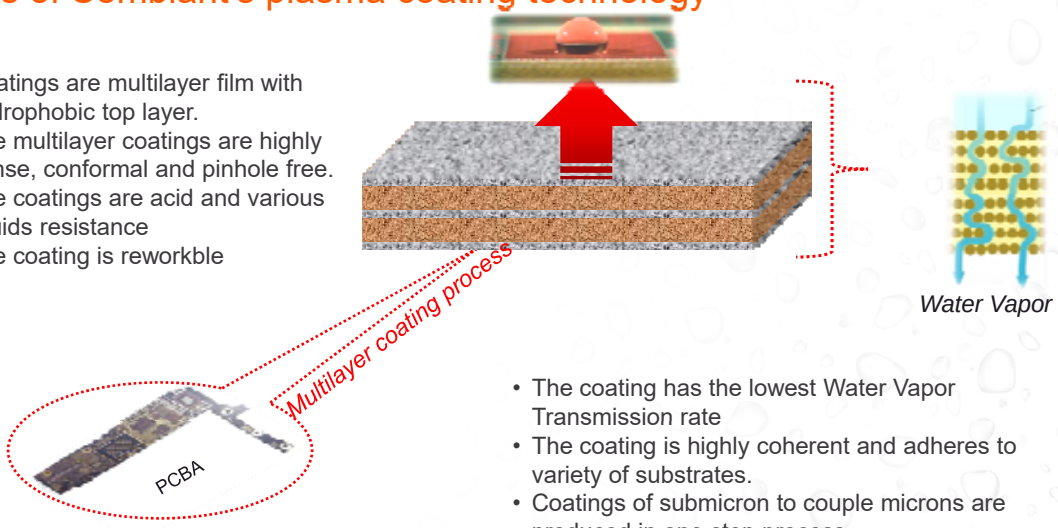
Semblant plasma technology in a nutshell

PCB/

Semblant 8

Benefits of Semblant's plasma coating technology

- Coatings are multilayer film with hydrophobic top layer.
- The multilayer coatings are highly dense, conformal and pinhole free.
- The coatings are acid and various liquids resistance
- The coating is reworkble

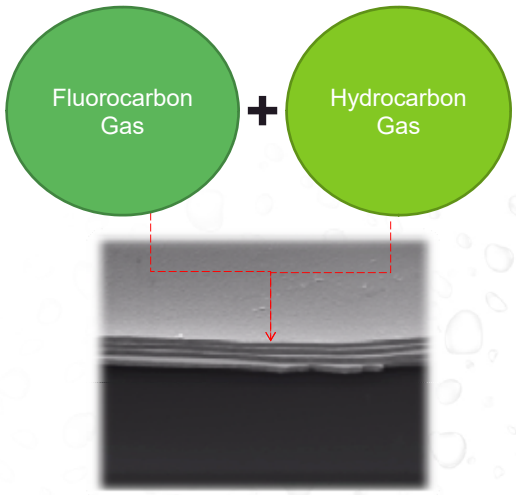


- The coating has the lowest Water Vapor Transmission rate
- The coating is highly coherent and adheres to variety of substrates.
- Coatings of submicron to couple microns are produced in one step process

Semblant 9

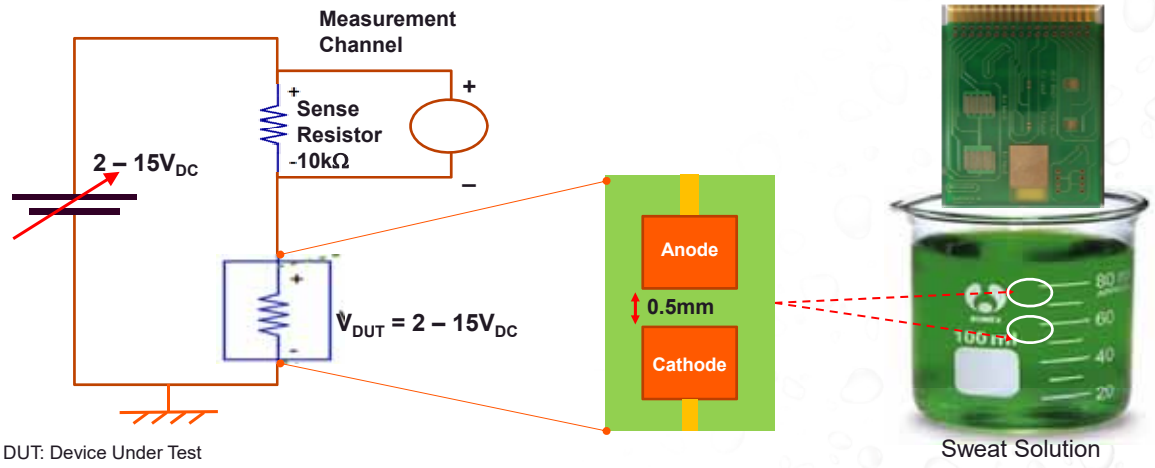
Semblant Coating Performance

- Semblant plasma polymerized thin film multilayer conformal coatings enhance the reliability of printed circuit boards (PCB) operating in harsh or extreme environments by providing protection from:
  - High Temperatures
  - Salt Spray
  - Humidity
  - Condensation
  - Water immersion
  - Noxious/Corrosive Gases
  - Solvent Splash/Spill/Immersion



Semblant 10

Immersion Sweat Testing is Much Harder than IPX & Mimics Real Life Failure

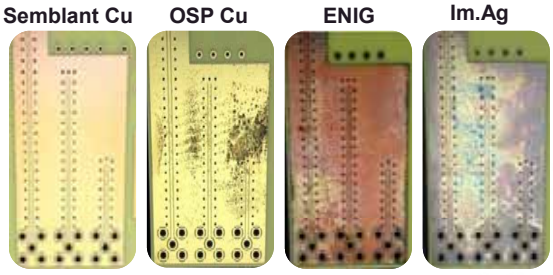


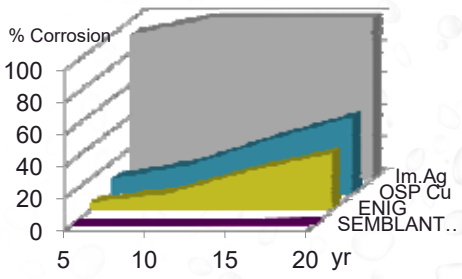
- Semblant-coated PCBAs are submersed for 24–48 hours and biased with up to 15V$_{DC}$.
  - This test simulates real world electronics failure modes better than IPX tests.

Semblant 11

It's Not Pure Water Protection That's Needed | It's Corrosion Protection

Test Conditions (Simulated 20yr Life)				Gas (ppb)			
Env.	Temp. (°C)	RH (%)	Time (days)	H_2S	SO_2	NO_2	Cl_2
Class IIIA	30	70	20	100	200	200	20

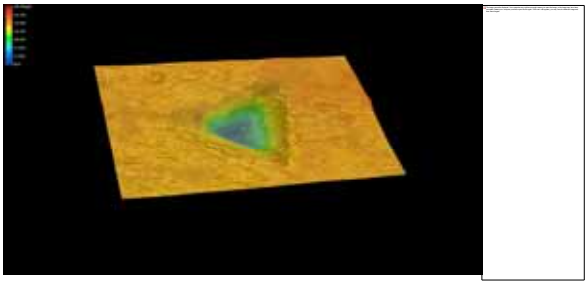


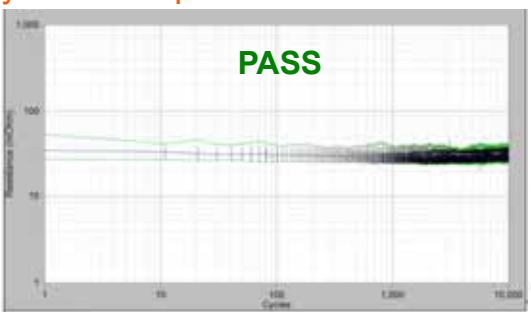


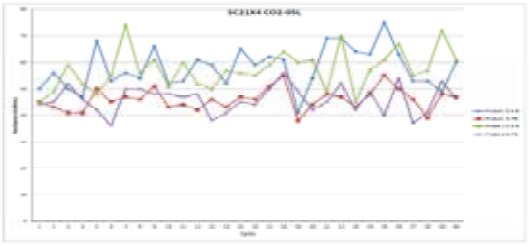
- Semblant's Nanocoatings work in harsh Under-the-Hood and mining environments.
  - That same corrosives also gradually attack Smartphones and consumer devices.

Semblant 12

Probe-ability Testing On Semblant Provia System Samples







- Tested SC21X3 and SC21X4 on copper coupons coated in China lab
- Probe through our coatings was successful at 0.5N force.

The imprint left on the Cu coated boards after a cycle. The penetration appears to be on the order of 0.0003" ~ 8um.

Semblant 13

Complete Reliability Certification

Type of Property	Property	Relevant Standard	Value
Environmental	Insulation Resistance	IPC-TM-650 2.6.3.4	4.8x10^13 Ohms
	Moisture Insulation Resistance	IPC-TM-650 2.6.3.4	3.4x10^11 Ohms
	Temperature and Humidity Aging	IPC-TM-650-2.6.11.1	PASS
	Flammability	UL94	PASS [V0]
	Glass Transition Temperature	ASTM D3418-03	Onset 1 +/- 1°C Tg 25 +/- 2°C
	Breakdown Temperature	TGA (10% wt loss in air)	>300°C
Chemical	Cross Hatch Adhesion test	IPC-TM-650 2.4.1.6	Class 3
	Water Contact Angle	ASTM D7334-08	95°
	PFOS / PFOA compliant	US EPA 3550C:2007	PASS – none detected
	Fungus Resistance	ASTM G21	PASS – zero growth
	Immersion Resistance to Sweat solution	Coated STC-13 circuit board fully functional after test	2V – 30min 5V – 5min 10V – 1.5min
Optical	Surface Energy	ISO 8296, Dyne Pens	< 22 Dynes / cm
	Transparency – visible light	IPC-CC-830B 3.5.2	PASS
Physical	Appearance	IPC-CC-830B 3.5.2	PASS
	Typical Thickness Range in use	n/a – Dektak used	1.0 - 3.0 microns
	Flexibility	IPC-TM-650 2.4.5.1	PASS
	Pencil Hardness	ASTM-D3363	4H
Electrical	Dielectric Constant (1MHz)	ASTM-D150	2.67
	Loss Tangent (1Mhz)	ASTM-D150	0.012
	Dielectric Strength	ASTM-D149	4x10^8 V/m
	Dielectric Withstanding Voltage	IPC-TM-650 2.5.7.1	1000 V

Semblant 14

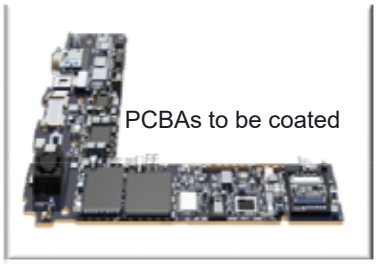
Our environmental difference: PFOA risks & why they are now critical

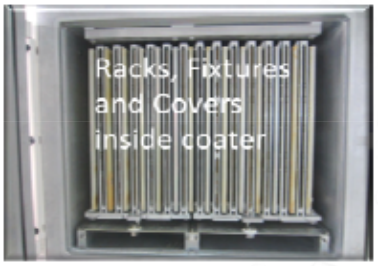
All of Semblant's coatings are entirely free of PFOA, PFOA-derivatives, and C6, thus protecting your consumers, employees, and corporation from legislation and litigation risks

PFOA (Perflurooctanoic Acid), its derivative PFOS, and long chain PFCs have been proven to be toxicants and carcinogens in humans, and they are known to persist and accumulate indefinitely in nature.

Semblant 15

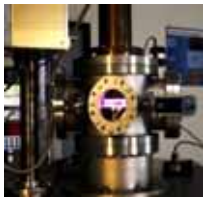
Semblant technology in action in high volume manufacturing (the real McCoy)





Semblant 16

Scalable Nanomaterials | Lab to High Volume Manufacturing (>1m/Day)



Patented Nanomaterials Created in Semblant Labs

High Mix Mfg. Or Repair

Volume Manufacturing 1000's Per Day

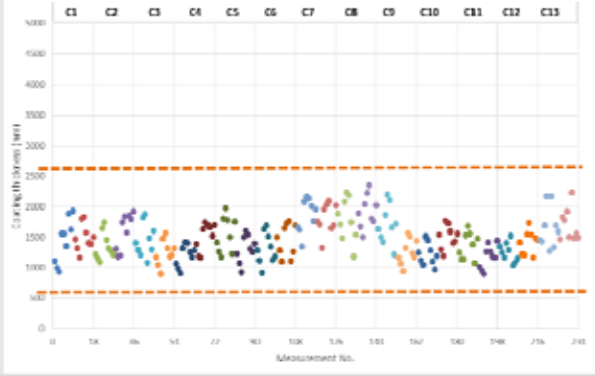
High Volume Manufacturing >10,000 Per Day

- Semblant's solutions are deposited using custom-designed Nordson March plasma systems, scaling from repair units to ultra high volume systems (>10,000 units/day).

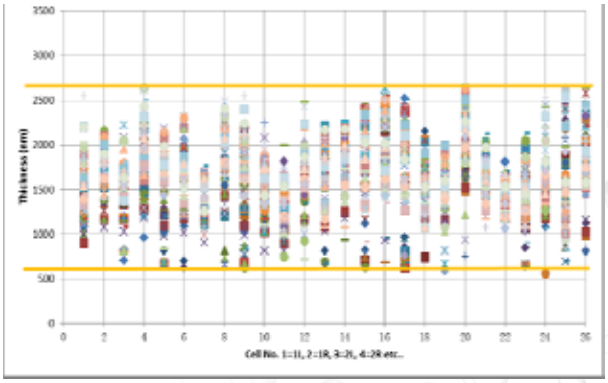
Semblant 17

Coating Uniformity Buy Off On Semblant Provia System

TYPICAL INDIVIDUAL COATER UNIFORMITY DATA

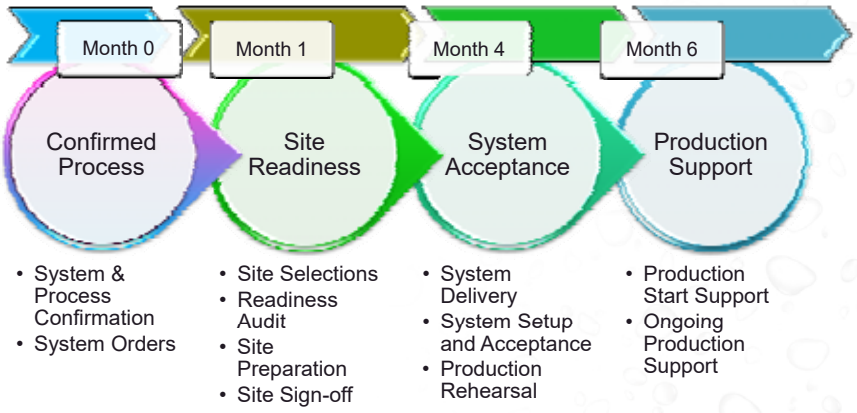


MACHINE-TO-MACHINE COATER UNIFORMITY DATA



Semblant 18

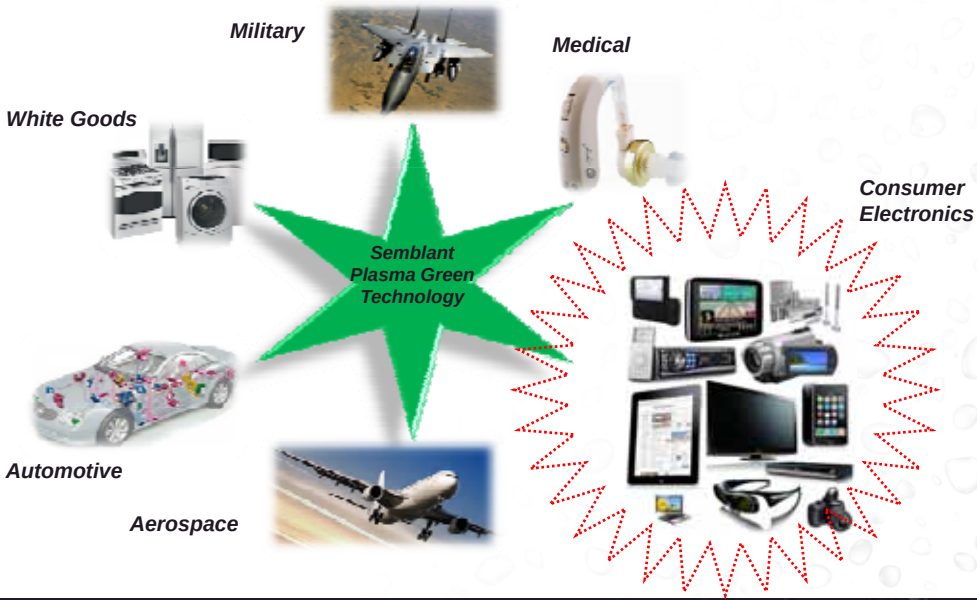
Our Proven Mass Production Deployment Timeline: 6 Months to HVM



• Semblant Provia equipment lead-time is 6 weeks for a multiple unit HVM system order.

Semblant 19

Market Served



Semblant 20

Competitive Analysis

		Semblant	Other Plasma	Parylene	Mech. Seals
Performance	Water Repellence (Hydrophobicity >100 Degrees)	✔	✔	✔	✖
	Corrosion Resistance (Liquid/Gas Agents)	✔	✖	✔	✔
	Submersion Protection (5V, 24hr, 100x City Water Solution)	✔	✖	✔	✔
	Aesthetics (Visual Appearance of Device & PCBA)	✔	–		✔
	Deposition Uniformity (Within Machine & Machine to Machine)	✔	–	✔	–
Manufacturability	High Process Throughput (Optimized for Mfg. & Cost)	✔	–	✖	✖
	Masking/Demasking NOT Required (Inc. Tooling Coat Removal)	✔	–	✖	–
	Reworkable (Able to Desolder/Resolder After First Coating)	✔	–	✖	✔
	Probe-Through (Ability for ATM Testers To Probe and Reprobe)	✔	✔	✖	✔
	Temperature Tolerance (Pb-free Reflow in Air or HTS)	✔	✔	✖	✔
Equipment	Equipment Robustness (Manufacturers Guarantee & Experience)	✔	✖	✖	–
	HVM Production Proven (10m+ units/month capacity)	✔	✔	✖	–
	Scalability (Ease of adding 10m units/month capacity)	✔	✖	–	✖
	HVM Yield Proven (99.9% Yield)	✔	–	–	–
	Proven China/Asia Support (Service Footprint & Years Experience)	✔	✖	✖	–
Reliability/Safety	Long term Reliability (Temp-Cycle, Degradation with Time)	✔	–	✔	✔
	No Reliability Risk to Other Components (Battery, Screen Etc.)	✔	✖	–	✔
	Complete Environmental Certification (inc. PFOA/PFOS Free)	✔	✖	✔	✔
	Closed Loop Feed and Exhaust Treatment (No Facility Nee	✔	✖	–	✔
	EH&S Certification & Proven In Production (UK, China, Asia, US)	✔	✖	–	✔
IP	All intellectual Property Risk (Owned or Multiple Licenses Needed)	✔	✖	✖	✖
Cost	Maximized Product Throughput (Units/Run)	✔	✖	✖	✖
	Economic Return Benefits Proven (>50% Return Production)	✔	–	✖	–
	Lowest Total Cost of Ownership (OpEx Equip/Mtrl/Process Cost)	✔	✖	✖	✖

Semblant 21

Better For The Environment | Better For the Consumer

- PFOA (Perflurooctanoic Acid), its derivative PFOS, and long chain PFCs have been proven to be toxicants and carcinogens in humans, and they are known to persist and accumulate indefinitely in nature.
- Leading brands have outlawed PFOA, PFOS and PFCs, as has Semblant, unlike most hydrophobic coating suppliers.

Semblant 22

Our Worldwide Support Footprint

Cambridge U.K.

California (Silicon Valley) U.S.

China (Zhuhai)

- Cambridge UK: Dedicated Research & Development facility with PhD material scientists and plasma physicists developing proprietary Nanocoatings (and associated IP) from first principles.
- Silicon Valley, California: New specialized center for US based customers, or those with Silicon Valley offices.
- Contract Manufacturers: multiple contract manufacturers have deployed Semblant production ramps in China/Asia.
- Zhuhai China Coating Center: enabling customers to access state of the art high volume production machines, including all input/waste systems and quality control metrology.

Semblant 23

How Semblant technology can help electronic devices?

PCBA(Flex or Rigid) manufacturers are constantly facing challenges in finding cost effective and environmentally benign materials to mitigate signal loss, RF interferences, and applicable to ultra-fine pitch micro CSPs (chipscale packages).

Corrosion in electronics components is insidious and more deleterious to wearable electronics due to their miniature size and exposure to various environmental conditions.

Semblant uses state-of-the-art plasma conformal coating technology (materials, process and equipment) to protect all kinds of PCBAs against liquids, environmental conditions and sweat.

With the proven track record of implementing the plasma technology in high volume manufacturing for smart phones, wearable devices can also reap the benefits.

Semblant 24

In summary

Ships don't sink because of water around them. Ships sink because of the water that gets in them. Don't let the water that gets inside your electronic devices ruin them - talk to Semblant.

Semblant 25

Thank You

Semblant 26