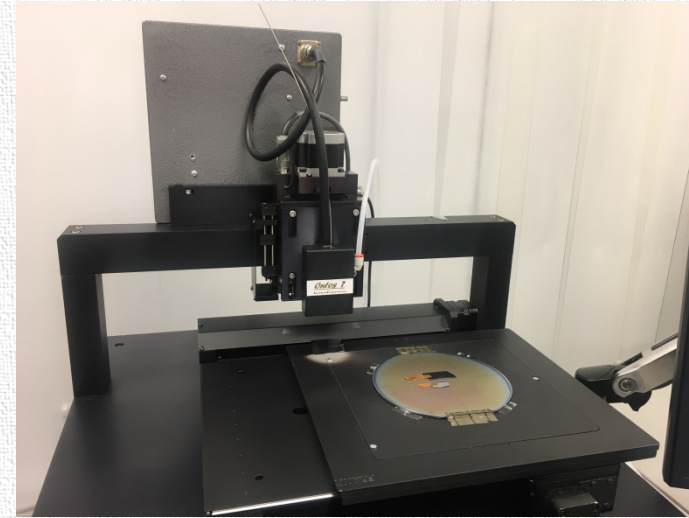


**EVALUATING SURFACE WETTABILITY FOR
ONTOS ATMOSPHERIC PLASMA
TREATED SAMPLES**

Courtesy of

- Evaluate the surface preparation of the SET-NA Ontos atmospheric plasma system for various surfaces during our visit to Ventura, CA.
 - Measure contact angle of different surfaces using BTG Labs Surface Analyst SA3001 to determine the wettability of the solid surface before and after treatment
- Compare wetting contact angle of ONTOS Atmospheric Plasma treated samples to other comparable systems.
 - Included a comparable open atmospheric plasma system and low pressure plasma chamber

Note: Parameters used on all systems tested were existing recipes and can be further optimized which may improve wettability

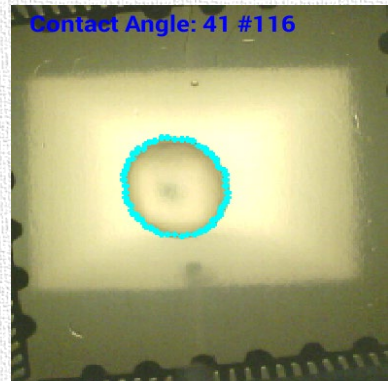




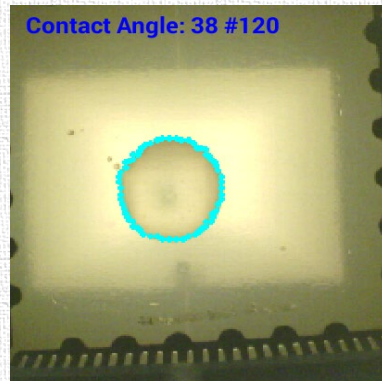
Calibration - PASS

All 5 contact angle measurements must be $\pm 2^\circ$ from 75°

ENIG GOLD (QFN PACKAGE SAMPLE)



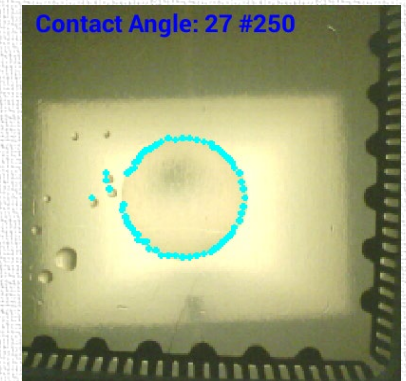
Untreated Baseline



Atmospheric Plasma System "A"



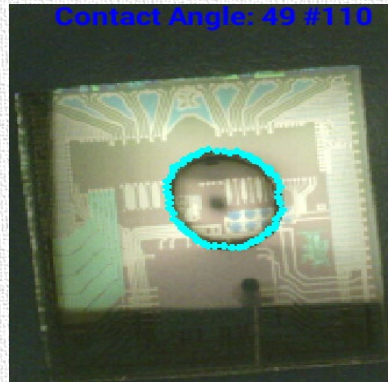
Low Pressure Plasma Chamber



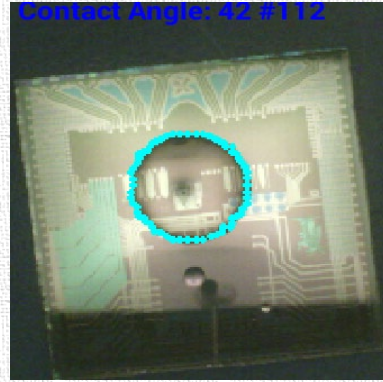
Ontos Atmospheric Plasma System

System	Profile (Gas)	Av. Wetting Angle	Std. Deviation
Baseline (Untreated Sample)	N/A	42.67°	2.89
Atmospheric Plasma System "A"	Compressed House Air	37.33°	2.08
Low Pressure Plasma Chamber	100% Ar	32.67°	3.06
Ontos Atmospheric Plasma System	Mixture He and H	27°	N/A

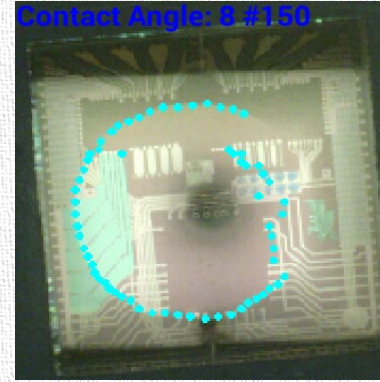
Ontos performed superior to a comparable atmospheric plasma system and low pressure plasma chamber in improving the wettability of the gold surface sample.



Untreated Baseline



Atmospheric Plasma System "A"



Low Pressure Plasma Chamber



Ontos Atmospheric Plasma System

System	Profile (Gas)	Av. Wetting Angle	Std. Deviation
Baseline (Untreated Sample)	N/A	47°	6.11
Atmospheric Plasma System "A"	Compressed House Air	41.67°	5.51
Low Pressure Plasma Chamber	100% Ar	8°	0.00
Ontos Atmospheric Plasma System	Mixture of He and H	~ 35°	N/A

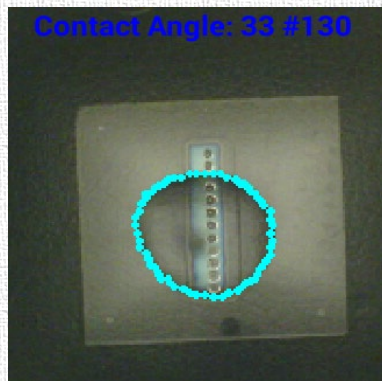
Ontos performed superior to a comparable atmospheric plasma system. Low pressure plasma chamber utilized a different gas and was able to get improved wettability of the sapphire surface sample.

Note: With Ontos, the Contact angle is slightly less than measured 35° due to poor lighting contrast at time of measurement.

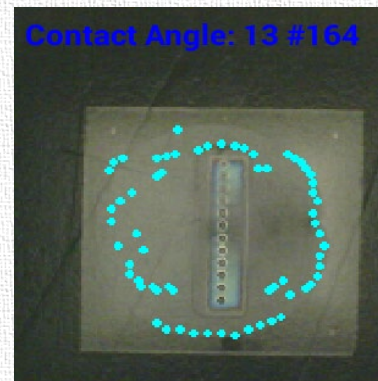
FUSED SILICA (1x12 LENS ARRAY SAMPLE)



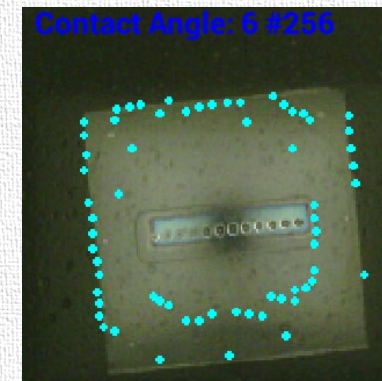
Untreated Baseline



Atmospheric Plasma System "A"



Low Pressure Plasma Chamber



Ontos Atmospheric Plasma System

System	Profile (Gas)	Av. Wetting Angle	Std. Deviation
Baseline (Untreated Sample)	N/A	39.33°	4.16
Atmospheric Plasma System "A"	Compressed House Air	34°	3.61
Low Pressure Plasma Chamber	100% O ₂	13.33°	0.58
Ontos Atmospheric Plasma System	Mixture: Oxygen - Helium	<6°	N/A

Ontos performed far superior to a comparable atmospheric plasma system and low pressure plasma chamber in improving the wettability of the fused silica surface sample.

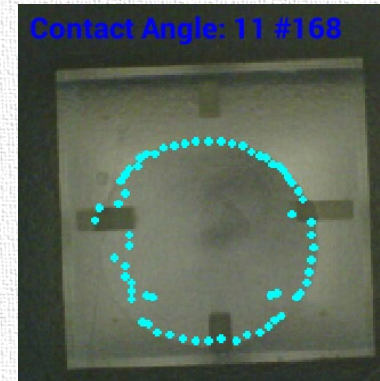
Note: With Ontos Treatment, water droplet wet entire component, making the contact angle difficult to measure and less than the recorded 6°.



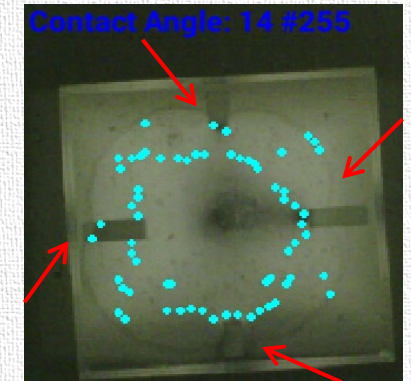
Untreated Baseline



Atmospheric Plasma System "A"



Low Pressure Plasma Chamber



Ontos Atmospheric Plasma System

System	Profile (Gas)	Av. Wetting Angle	Std. Deviation
Baseline (Untreated Sample)	N/A	18.33°	1.53
Atmospheric Plasma System "A"	Compressed House Air	27°	4.58
Low Pressure Plasma Chamber	100% O ₂	9.67°	1.53
Ontos Atmospheric Plasma System	Mixture: Oxygen - Helium	*14°	N/A

***Edge detection software did not accurately detect the edges of the droplet. Real measurement <11° and comparable to low pressure plasma chamber.**

Water droplet extends passed all 4 "cleats" on the sample and is larger than the low pressure plasma chamber sample, meaning contact angle is actually <11°

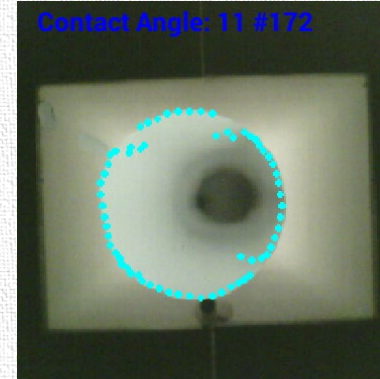
SURFACE: SILICON (POLISHED SIDE OF WAFER)



Untreated Baseline



Atmospheric Plasma System "A"



Low Pressure Plasma Chamber



Ontos Atmospheric Plasma System

System	Profile (Gas)	Av. Wetting Angle	Std. Deviation
Baseline (Untreated Sample)	N/A	63°	1.00
Atmospheric Plasma System "A"	Compressed House Air	62.33°	0.58
Low Pressure Plasma Chamber	100% Argon	10.33°	0.58
Ontos Atmospheric Plasma System	Mixture: Oxygen - Helium	6°	N/A

Ontos performed far superior to a comparable atmospheric plasma system and low pressure plasma chamber in improving the wettability of polished Silicon wafer surface sample.

- ONTOS Atmospheric Plasma System samples showed improved wettability for all surfaces after treatment.
- ONTOS Atmospheric Plasma surface samples recorded better wettability angles than a comparable open atmospheric plasma system.
- Sapphire surface was the only sample treated where the low pressure plasma chamber measured a significantly lower contact angle than the ONTOS Atmospheric Plasma System.