Evaluating Surface Wettability for SET-NA Ontos7 Atmospheric Plasma Treated Samples

October 19, 2017

Purpose

Evaluate the surface preparation of the SET-NA Ontos7 atmospheric plasma system for various surfaces during our visit to Ventura, CA on 10/4/17.

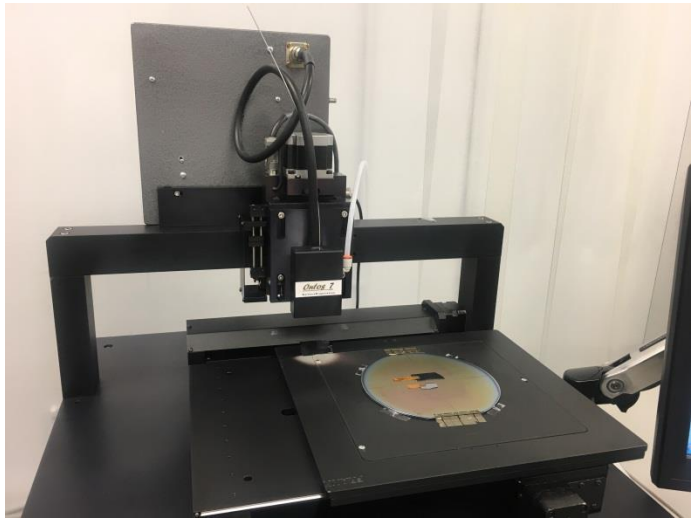
- Measure contact angle of different surfaces using BTG Labs Surface Analyst SA3001 to determine the wettability of the solid surface before and after treatment

Compare wetting contact angle of SET-NA Ontos7 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

SET-NA Ontos7 Atmospheric Plasma System



BTG Labs Surface Analyst SA3001

10/3/17 Calibration - PASS

All 5 contact angle measurements must be ± 2° from 75°

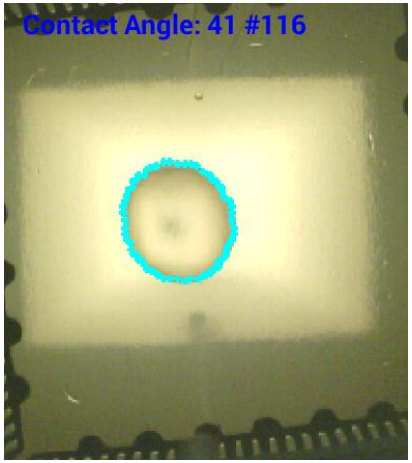
ULTRA COMMUNICATIONS

Surface: ENIG Gold (QFN Package sample)

System	Profile (Gas)	Avg. Wetting Angle	Standard Dev
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
SET-NA Ontos7 Atmospheric Plasma System	Mixture of Helium and Hydrogen	27°	N/A

SET-NA Ontos7 performed superior to a comparable atmospheric plasma system and low pressure plasma chamber in improving the wettability of the gold surface sample.

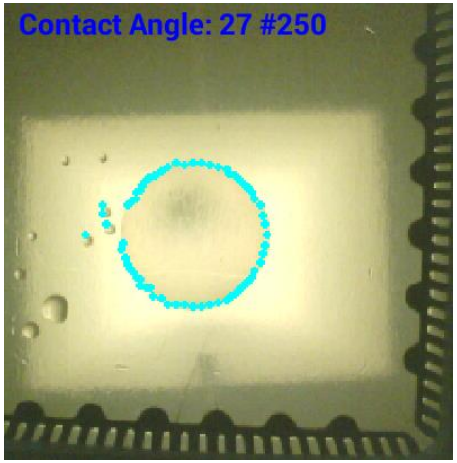
Surface: ENIG Gold (QFN Package sample) (cont.)



Untreated Baseline

Atmospheric Plasma System "A"

Low Pressure Plasma Chamber



SET-NA Ontos7 Atmospheric Plasma System

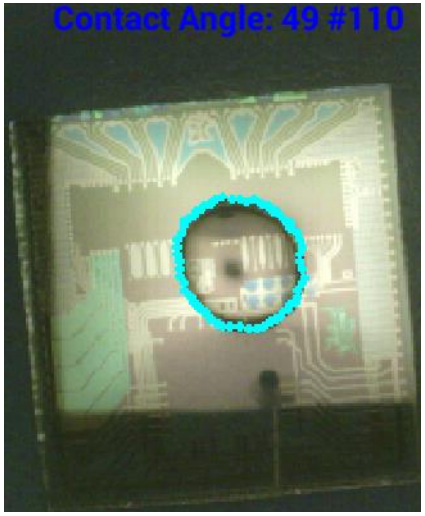
ULTRA COMMUNICATIONS

Surface: Sapphire

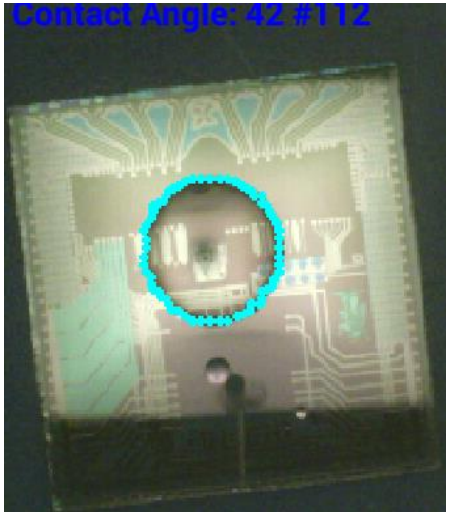
System	Gas	Avg. Wetting Angle	Standard Dev
Baseline (Untreated Sample)	N/A	47°	6.11
Atmospheric Plasma System "A"	Compressed House Air	41.67°	5.51
Low Pressure Plasma Chamber	100% Ar	8°	0.00
SET-NA Ontos7 Atmospheric Plasma System	Mixture of Helium and Hydrogen	~35°	N/A

SET-NA Ontos7 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.

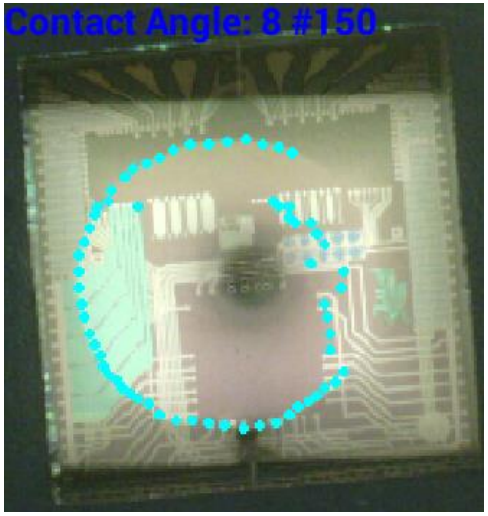
Surface: Sapphire (cont.)



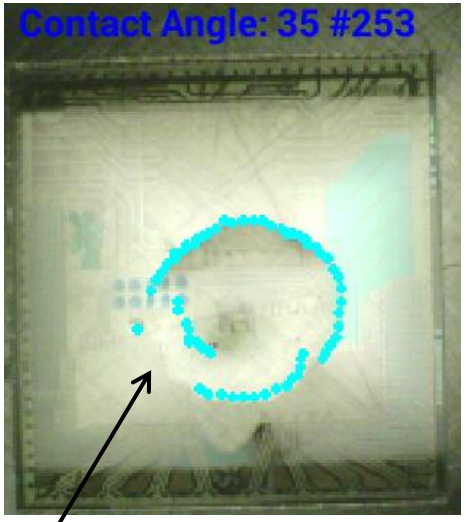
Untreated Baseline



Atmospheric Plasma System "A"



Low Pressure Plasma Chamber



SET-NA Ontos7 Atmospheric Plasma System

Contact angle slightly less than measured 35° due to poor lighting contrast at time of measurement.

ULTRA COMMUNICATIONS

Surface: Fused Silica (1x12 Lens Array sample)

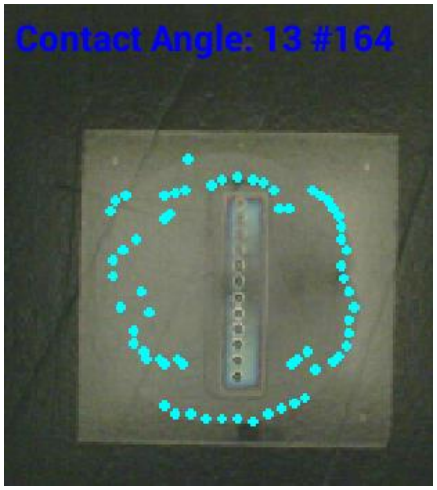
System	Profile (Gas)	Avg. Wetting Angle	Standard Dev
Baseline (Untreated Sample)	N/A	39.33°	4.16
Atmospheric Plasma System "A"	Compressed House Air	34°	3.61
Low Pressure Plasma Chamber	100% O_2	13.33°	0.58
SET-NA Ontos7 Atmospheric Plasma System	Mixture of Oxygen and Helium	<6°	N/A

SET-NA Ontos7 performed far superior to a comparable atmospheric plasma system and low pressure plasma chamber in improving the wettability of the fused silica surface sample.

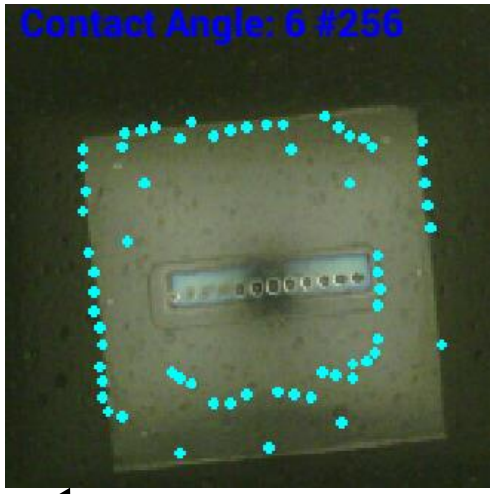
Surface: Fused Silica (1x12 Lens Array sample) (cont.)

Untreated Baseline

Atmospheric Plasma System "A"



Low Pressure Plasma Chamber



SET-NA Ontos7 Atmospheric Plasma System

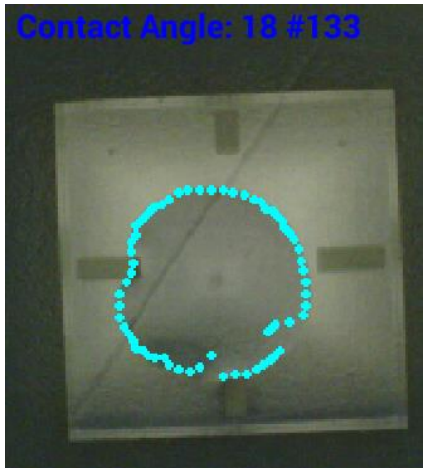
Water droplet wet entire component, making the contact angle difficult to measure and less than the recorded 6°.

Surface: APEX Glass (Lens Guide sample)

System	Profile (Gas)	Avg. Wetting Angle	Standard Dev
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
SET-NA Ontos7 Atmospheric Plasma System	Mixture of Oxygen and Helium	*14°	N/A

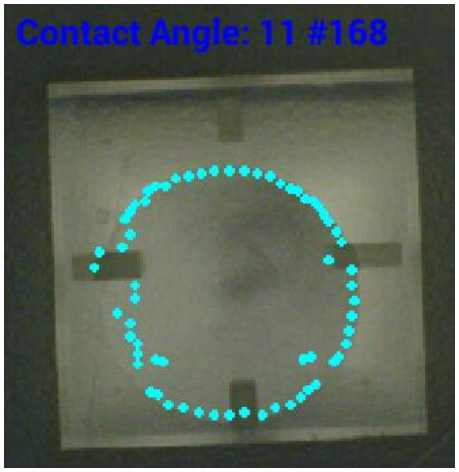
*Edge detection software did not accurately detect the edges of the droplet. Real measurement <11° and comparable to low pressure plasma chamber.

Surface: APEX Glass (Lens Guide sample) (cont.)

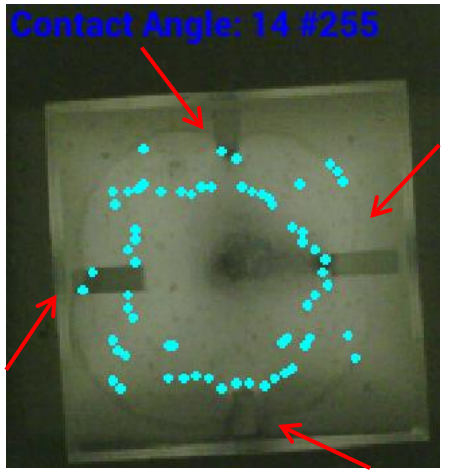


Untreated Baseline

Atmospheric Plasma System "A"



Low Pressure Plasma Chamber



SET-NA Ontos7 Atmospheric Plasma System

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° .

ULTRA COMMUNICATIONS

Surface: Silicon (Polished side of Wafer)

System	Profile (Gas)	Avg. Wetting Angle	Standard Dev
Baseline (Untreated Sample)	N/A	63°	1.00
Atmospheric Plasma System "A"	Compressed House Air	62.33°	0.58
Low Pressure Plasma Chamber	100% Ar	10.33°	0.58
SET-NA Ontos7 Atmospheric Plasma System	Mixture of Oxygen and Helium	6°	N/A

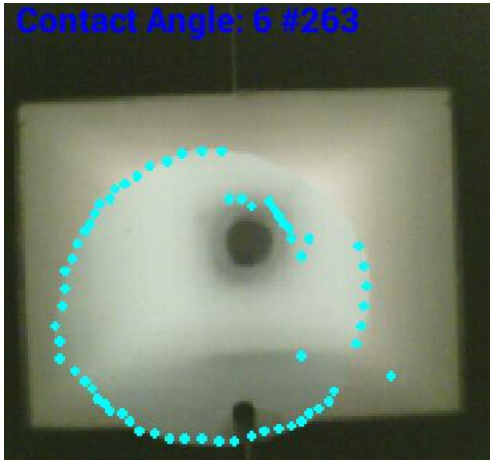
SET-NA Ontos7 performed far superior to a comparable atmospheric plasma system and low pressure plasma chamber in improving the wettability of polished Silicon wafer surface sample.

Surface: Silicon (Polished side of Wafer) (cont.)

Untreated Baseline

Atmospheric Plasma System "A"

Low Pressure Plasma Chamber



SET-NA Ontos7 Atmospheric Plasma System

Conclusions

SET-NA Ontos7 atmospheric plasma system samples showed improved wettability for all surfaces after treatment.

All Ontos7 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 Ontos7 system.