TECHNICAL DATA BULLETIN

SCA Water Rinse System ‡

A Concentrated, Water Rinse Additive for Glycol Slurry Cleaning / Rinse Applications

PPT Research has developed a human safe, environmentally friendly, water-soluble, non-foaming, biodegradable water rinse additive designed to be a drop-in replacement for existing water rinse detergents used for the removal of glycol based spent abrasive slurry from wiresaw cut ingots. SCA is a concentrated water-based additive that is diluted with water using ratios up to 100:1 (Water:SCA). PPT has conducted a series of comparative studies between its SCA Rinse Aid and other "Standard" detergent based rinse additives under identical conditions. Values obtained in the data below are from repetitive tests performed on calibrated laboratory equipment, or from identical test methods and conditions for relative comparisons of measured properties. Conclusions made are the result of the values obtained from each comparison test performed at PPT Research, Inc.

Spread-ability/Penetration

PPT employed a semi-quantitative method to determine the ability of a liquid to penetrate and spread across a silicon surface. ~3-4 ml of each diluted water rinse solution was placed on a flat dry silicon wafer at ambient temperature and humidity conditions. The rate at which the liquid spreads across the silicon surface as determined by the changing diameter of the initial "drop" is a measure of the relative spreading characteristic of the rinse solution, and the effectiveness of penetration into small diameter kerf slots during use. The greater the value measured in centimeters, the greater the "spread-ability" and penetration performance of the water rinse solution at the given concentration.

Rinse Aid or Detergent	Active Detergent Type	Active Water Concentration (wt %)	Spread Time / Drop Diameter (cm)		
			0 sec	60 sec	120 sec
SCA Conc.	Formulated	~0.15	1.0	2.2	3.8
D.I. Water	---	---	1.0	1.0	1.0
Commercial-A	Na-EDTA	~0.10	1.0	1.1	1.2
Commercial-B	Anionic/nonionic	~0.5	1.0	1.5	1.8
Commercial-C	Organic sulfate salt	~0.20	1.0	1.3	1.5
Commercial-D	Water soluble Polymer	~0.15	1.0	1.7	2.5

This simple test shows that the SCA rinse system exhibits superior spreading and penetration on a silicon surface compared to other commercial or standard detergents / rinse-aids. Of note is the fact that the SCA formulation demonstrates superior spreading characteristics even though its effect on lowering the surface tension of water is not the best among those commercial "detergents" tested (See Surface Tension table below).

Surface Tension

Surface tension defined as the amount of work needed in dynes/cm to create a unit area of air-liquid interface. In more practical terms, it is related to the resistance to flow of a liquid across a defined solid surface and can be correlated to contact angle of the liquid on a defined solid surface. In other words, it is indirectly and inversely related to the penetration and spreading of a liquid along a defined solid surface or into very small cracks, holes, channels, etc. of a surface.

In general, lower measured surface tension for a liquid typically relates to a lower resistance to flow of the measured liquid. Often, but not always, this may result in increased penetration and spreading properties of the liquid on a solid surface or within narrow slots. But, since surface tension of a liquid is only one of several mathematical components defining spreading characteristics of a liquid on a defined solid surface, the lowest liquid surface tension may not yield the greatest spreading characteristics. Such is the case with the unique SCA Rinse Aid formulation.

As the table below shows, SCA yields a very low surface tension, but not as low as some commercial detergents. However, performance of a water rinse aid is primarily determined by the increased penetration and spreading characteristics of water imparted by the detergent or rinse aid. The above table clearly demonstrates that the SCA system provides the greatest increase in spreading characteristics for water. This defining property sets the SCA apart from other detergents or rinse aids which improperly measure rinsing performance as a function of surface tension, rather than spreading properties.

Rinse Aid or Detergent	Active Detergent Type	Active Water Concentration (wt %)	
			Surface Tension in Dynes / cm (#)
SCA Conc.	Formulated	~0.15	27
D.I. Water	---	---	70
Commercial-A	Na-EDTA	~0.10	29.9
Commercial-B	Anionic/nonionic	~0.5	26.4
Commercial-C	Organic sulfate salt	~0.20	48.6
Commercial-D	Water soluble Polymer	~0.15	20.4

(#) Surface tension values measured using a Pt-ring tensiometer – Fisher Model 21 Surface Tensiometer.

The results in the above table are consistent with the fact that surface tension is only one of several components related to spreading, and that the relationship is an inverse correlation between these two properties. Of special note is the fact that although the surface tension for the SCA rinse aid is not the lowest among the commercial materials tested, the SCA still demonstrates superior spreading characteristics to those commercial detergents with lower surface tension values than SCA.

Rinse Foaming

Foaming greatly diminishes the effectiveness of any rinse aid as the bubble membranes of the foam block or inhibit the penetration and spreading of the water rinse into narrow kerf slots, over the silicon surface or into other small channels where spent slurry must be removed. Rinse aids that exhibit any foaming will suffer in rinse efficiency where bubble membranes are in contact with the ingot surface. They should be limited to direct, total immersion rinsing to help ensure effective removal of slurry. Such limitations do not exist with the SCA system.

SCA is designed to prevent foaming without any negative effect on the spreading, wetting, penetration or surface tension properties of the fully diluted water rinse system. This means that SCA is applicable and very effective with all water rinse methods including immersion, over-flow weir, spray rinse, vigorous agitation, etc.

Conclusions

1) PPT's SCA system demonstrates superior penetration and spreading characteristics on silicon surface compared to commercial detergents and rinse aids, regardless of surface tension values for these commercial materials.

2) While the lower measured surface tension for some commercial detergents might be expected to provide superior rinsing characteristics for a water based slurry rinse, this is not the case with other commercial detergents. Even when measured surface tension values are lower than that for SCA, the measured spreading properties of these materials are noticeably inferior to that of the SCA system.

3) The SCA system demonstrates a unique ability to spread more extensively and faster on silicon than any of the commercial detergents tested, even if the detergent concentration in water is as much as 300% that of the SCA system.

4) Unlike many of the commercial detergents and rinse aids tested, the SCA system will not foam, whether used in an overflow weir configuration or as a spray rinse.

5) SCA does not exhibit any applications restrictions due to other products exhibit foaming. Detergents / rinse aids that exhibit foaming under wafer rinse conditions are limited to direct immersion rinsing in order to ensure effective removal of slurry. Such limitations do not exist with the SCA system.

‡ SCA rinse aid comprises the SCA product concentrate, which is diluted at the rinse station with water at ratios from ~30:1 to ~100:1 (Water:SCA) depending on water source conditions.