

# CMP Filter Efficiency

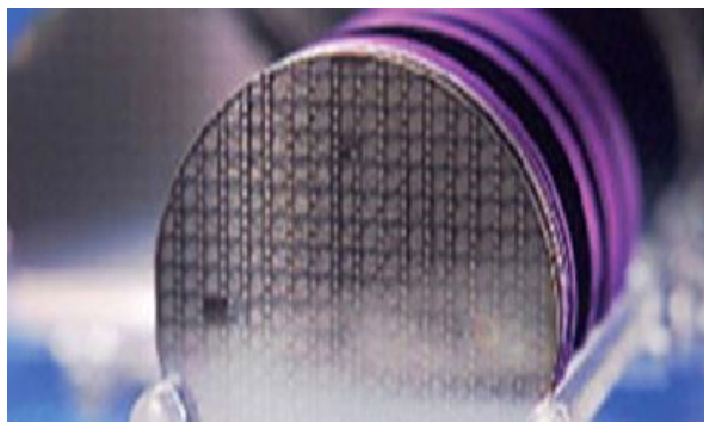
AccuSizer®

## OVERVIEW

CMP solutions play an integral role in the semiconductor technology highway. They are an essential step in the production of high-density integrated circuits. CMP solutions are complex dispersions made up of many components. The production and stability of these colloidal systems is very complex and hard to predict, therefore they have to be monitored during production, and even after, prior to final shipment. Some CMP suspensions exhibit unique behaviors that are affected by shear and mechanical stress causing irreversible agglomeration. These low levels of agglomerates often cause scratches during the wafer process, that sometimes are not discovered until well into production, resulting in major financial losses to the end user. The AccuSizer® has played, and continues to play, a major role in the complete product chain of CMP slurry manufacturing and use. From raw material suppliers, CMP slurry manufacturers, slurry distribution suppliers, filter suppliers, and chip manufacturers, Entegris and the AccuSizer have been actively detecting and providing information on good and bad slurries for over 50 years.

## INTRODUCTION

CMP slurries are often filtered as part of their production process and during their use. It is believed that by using a filter, the large particles that are formed during the process can be removed from the slurry and the result will be no scratched wafers. In some cases, the lifetime of the filter is compromised, and large particles form after filtration causing defects on wafers. Without a method to monitor and quantify the tails of large particles, pre-and post-filtration companies have resorted to changing the filters more often, wasting time and money. Now there are a few analytical methods that may be used to detect the presence of the large particle agglomerates that form during the filtration process. Classical light scattering is one method but it has its limitations. When using classical light scattering particle sizers, it is impossible to detect whether the filtration process is working and removing the large particle tail of agglomerates that has been directly related



to wafer scratches. Classical light scattering provides size information as an averaged mean, and it does not have the sensitivity to detect those few outliers that are present. A second method is single particle optical sizing (SPOS), where the light blockage is used to count and size each particle one-at-a-time.

## ACCUSIZER SINGLE PARTICLE OPTICAL SIZING (SPOS)

The AccuSizer is both a particle counter and a high resolution particle sizing analyzer which employs the method of SPOS. It is the first fully automated single particle sizer to provide high resolution particle size distributions without any assumptions concerning the shape of the distribution. The raw data reported by the instrument are particle counts versus size. Using simple statistics, the software can convert these data points into a host of other useful weighted distributions (i.e.; volume, area, number, volume/surface, etc.) and provide accurate statistical information that is traceable to the raw data.

The AccuSizer has the sensitivity to detect the large particle counts (typically  $>1.0 \mu\text{m}$ ) at the tail of the distribution with sensitivity over 600 times greater than laser diffraction.<sup>1</sup> The use of the AccuSizer to monitor filters has increased their life span, and in many cases the return on investment for the tool is paid for in a matter of months.

## RESULTS

Figure 1 clearly displays the ability of the AccuSizer to both quantify and resolve the amount of large particles in the tail of the CMP slurry pre-and post-filtration. The data displayed in blue shows the CMP slurry prior to being filtered. CMP slurry post-filtration is displayed in red.

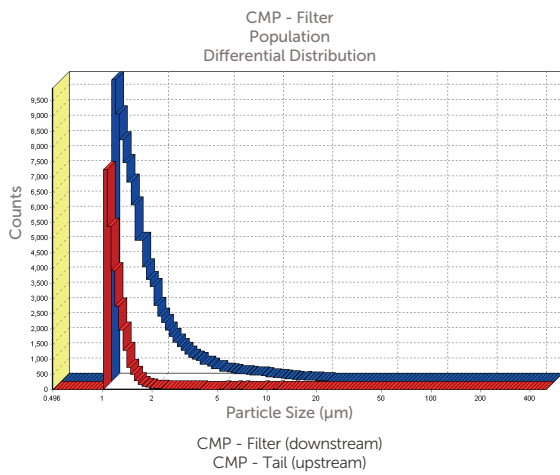


Figure 1. CMP slurry before (blue) and after (red) filtration

Figure 2 shows how the AccuSizer was used to determine the optimum filter specification to use to reduce the LPC count in a CMP slurry.<sup>2</sup> The slurry was recirculated without a filter, and then through a 10, 5, and 1 µm filter. Clearly the 1 µm filter does the best job reducing the LPC count.

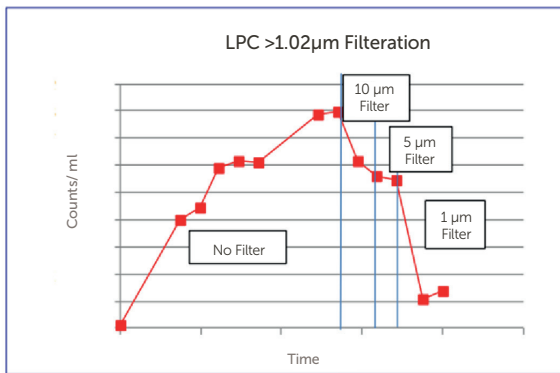


Figure 2. Choosing the best filter by AccuSizer

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The AccuSizer Mini can also be installed at point of use to guard against high LPC slurries touching wafers. In addition, the Mini system is used to determine when filters need replacement, optimizing the filter maintenance schedule and saving money. Figure 4 shows AccuSizer Mini data over several days from a fab where filter replacement is based on LPC count.

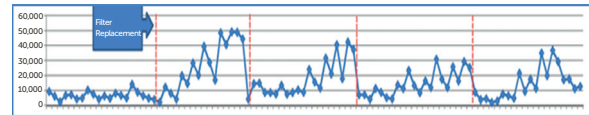


Figure 4. LPC data in particles/mL >1 µm from the AccuSizer POU system

#### CONCLUSIONS

The AccuSizer can efficiently monitor filter life span, and has the sensitivity to accurately detect the presence of large particle aggregates that can cause wafer scratches. The AccuSizer is available for laboratory and online applications.

#### References

- Entegris Application Note, LPC Tails in CMP Slurries
- Bridger, P, challenges of slurry distribution system simulation for fumed silica based slurry, 2013 levitronix user conference, available at <https://www.levitronix.com/en/levitronix-conference-papers.html>



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