Graver Technologies

Technical Brief

TB–002

QXL Series Filters - Select Application Details

CMP Slurries

Chemical Mechanical Planarization (CMP) is a polishing process used to manufacture wafers for the semiconductor industry. It requires the use of a polishing tool and polishing slurry, manufactured by companies such a Cabot, Fujimi, Rohm and Haas, Hitachi Chemical and Ferro Industries. The slurry in the tool is delivered to the wafer surface and may contain large particles/ agglomerates (> 1 micron) as a result of shipping/handling issues, drying, and interactions within the slurry distribution systems. These large particles can, in turn, increase the level of defects (scratches) on the semiconductor wafer surface found after the CMP process has been completed.

One of the solutions for decreasing the level of defects caused by large slurry particles is through the use of slurry filtration. There are currently two preferred methods of slurry filtration: 1) loop or recirculation filtration and 2) point-of-use (POU) filtration. Loop or recirculation filtration attempts to remove large particles from the slurry as it is recirculated through a distribution loop which delivers the slurry to the tools. For these applications, 0.5 to 5 micron filters are typically used and flow rates of 1 to 3 GPM per 10" filter are recommended.

POU filtration attempts to capture large particles at or near the point at which the slurry is dispensed onto the polishing pad. Flow rates for POU applications should not exceed .5 to 2.5 GPM per 10" filter. Both methods of filtration have tradeoffs with respect to the volume of slurry that can be filtered before filter failure and the size of the particles that can be filtered. POU filtration is preferred over loop filtration because of the ability to use submicron filters at low flow rates, which tends to decrease the occurrence of premature filter plugging and allows for the potential filtration of < 1.0 micron particles. POU slurry filtration has been shown to be beneficial in reducing wafer defects and increasing yields in CMP processes.

Traditionally, non-pleated filters have been used in both the POU and loop filter positions. These cylindrical depth filters can exhibit limitations in efficiency, dirt holding capacity (service life), flow rate and pressure drop. Conversely, single layer pleated filters offer better classifying performance, but can exhibit shorter filter life, suggesting that thin pleats have little support and bunch together in this type of high solids application.

QXL Series filters combine the best features of depth filters (ability to remove a range of particle sizes due to graded pore structure, stable media configuration) with the advantages of pleated filters (high surface area for improved flow rates, lower pressure drops and longer on-stream life). •

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Ink Jet Inks

Ink jet inks are manufactured in a variety of formulations. Some of the main variants include the carrier fluid - aqueous or solvent based as well as the colorant itself - pigment or dye based. Cleanliness of the ink is required to avoid plugging of the print head or nozzle to ensure printer performance and longevity.

Manufacturers of pigment based inks are seeking filtration that achieves highly selective (classifying) particulate removal. These filters must remove oversized pigments, gels, agglomerates and other contaminant, while allowing the desirable sized pigments to pass through the filter and remain in solution. For this application Graver recommends multi stage filtration with absolute rated QXL Series filters. Graver offers specially formulated ink jet grades with a multi layer structure that achieves fine dispersion classification along with reliable gel retention to meet the demands of ink jet formulators.

For dye based inks, the colorant is actually dissolved in the solution and so the goal of filtration is to remove gelatinous residues, insoluble dyes and other contaminant. In this case two stage filtration is recommended with a 0.5 micron absolute QXL Series filter selected as the prefilter followed by a 0.2 micron absolute rated WaterTec as a final filter.

Be sure to check for chemical compatibility when selecting filters for solvent based ink applications. In some instances the glass media in the Graver GFC Series may be the more appropriate choice. •

Ink Jet Inks

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Coatings

Coatings encompass a variety of solutions including paints, oils, varnishes and lacquers. These fluids may be very thin and low-viscosity in nature, to very thick, thixotropic liquids (viscosity reduces when flow/force or shear is applied) and come in a wide range of percent solids. Proper filtration selection requires a clear understanding of the nature of the formulation including the carrier fluid, the pigment characteristics (type, shape, size and flexibility), the resulting fluid properties (percent solids, viscosity and rheological (flow) properties), as well as the quality requirements for the coating itself.

Removal of paint contaminants can be challenging because the particulates are often soft, pliable and flexible, and easily clog any kind of filtration media, even if the filter is back-flushable. To capture these soft particles, depth media is typically recommended rather than a single layer pleated media because the thinner media may allow deformable contaminant to extrude through. The second challenge with coatings filtration is to select a filter with sharp cut-off characteristics to achieve efficient removal of the large, unwanted particles while maintaining the smaller pigment concentration. In this case, a pleated media is typically preferred because of its classifying capabilities rather than the broader clarifying attributes of a cylindrical depth filter. The filter selected for a coatings application is also expected to resolve quality problems that were not addressed during incoming inspection of raw materials, improper storage and temperature exposure of raw materials/ingredients, or errors in the manufacturing process. Finally the coatings manufacturer will require different filters to match the quality requirements for the particular coating. For example, manufacturers of automotive paints will have much higher demands for quality due to the higher cost of correcting defects resulting from particulate remaining in the paint, than would a house paint manufacturer.

With these seemingly contradictory demands, it seems a difficult task to find a filter that can possibly address the needs of the coatings manufacturer. However, the Graver QXL Series product addresses both the needs for deformable particle capture with its multi layered media, has superior flow characteristics compared to a conventional depth filter when filtering viscous fluids due to higher surface area, and exhibits sharp particle cutoff characteristics to allow desired pigment to remain in solution. The QXL Series is available in a choice of absolute rated grades to meet the quality requirements of the manufacturer. For fluids with high solids content, Graver recommends multi-stage filtration. •

Gel Filtration

Removal of gels from a solution is a common and challenging filtration problem. Gels are formed during a polymerization process (desired) or as a side reaction or under-reaction (undesired) during a manufacturing process. These gels form a cross-linked, networked structure and are not readily dissolved in solvents in the manufacturing state. Instead, they tend to swell to several times their original size when in contact with solvents.

Gels can present a filtration challenge in many diverse applications. These include photo chemicals, photo emulsions, cosmetics, paper coatings, adhesives, silicones, CD/DVD coatings, and magnetic media to name a few.

The primary filtration challenge is due to the gel's ability to deform upon application of stress. The degree of deformation is typically dependent upon the level of operating pressure (differential). At low to intermediate differential pressures, the gel particles can sufficiently deform to block filter media. Such complete blockage precludes the formation of a cake resulting in diminished filter life. However, if the differential pressure is elevated to maintain the flow through the filter, or recommended flow rates of 1 to 3 GPM per 10" (for 0.45 to 3 micron filters) are exceeded, then gels can sufficiently deform and extrude through the media, even those with rated pore diameters significantly less than the dimensions of the swollen gel particle itself.

Consequently, the selection of the optimum filter cartridge for gel removal depends upon the viscosity of the solution, the operating differential pressure, and the gel concentration. Depth media is generally recommended for removal of gels in highly viscous solutions with medium to high concentrations of gel particles. Depth filters, however, tend to be limited by the available surface area (<.75 sq ft per 10" filter) and thus may have short on-stream life. Traditional single layer pleated filters on the other hand have much higher surface area, but lack the depth necessary to prevent extrusion of the gel particles. A hybrid pleated/ depth filter such as the QXL overcomes the short-comings of both depth and pleated filters while offering high surface area for long life coupled with a layered depth media to prevent gel extrusion. •