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Precision Alumina Polishing

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Alumina Polishing Abrasives

Modern nanometer alumina or polycrystalline seeded jell alumina abrasives outperform traditional calcined alumina abrasives for fine surface finishing. In general, alumina abrasives are classified by their manufacturing process, crystal structure (hardness) and their sizing or classification process. The seeded jell alumina abrasives have a much tighter and better controlled particle size distribution and are ideal for fine polishing, whereas the calicned alumina powders are relatively inexpensive and are very useful for coarse polishing.

The other advantages of seeded jell polycrystalline alumina is that the very fine particle sizes (0.05 to 0.20 micron) are available in the harder alpha alumina (mohs hardness 9) crystal form, whereas fine calcined alumina is only available in the softer gamma (mohs hardness 8) structure. The seeded jell alumina particles also sharper and have a higher cutting surface area as compared to the platey shape of the calcined alumina's.

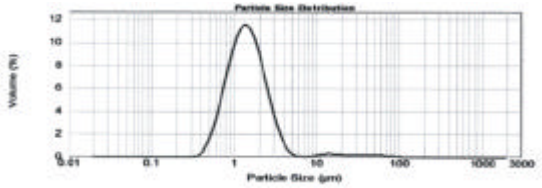
Alumina	Product name	Processing / form	pH	Application
Calcined	Alumina powders	Dry / powder	n.a.	Low cost abrasive for polishing hard materials.
Seeded jell	Nanometer acidic alumina	Wet / slurry	4.0	Excellent polish for metals, especially for CMP (chemical mechanical polishing) with low pH or acid solutions.
Seeded jell	Nanometer alumina	Wet / slurry	10.0	Excellent fine abrasive polish. High pH allows for better dispersion of alumina particles in slurry.

Seeded Jell Alumina

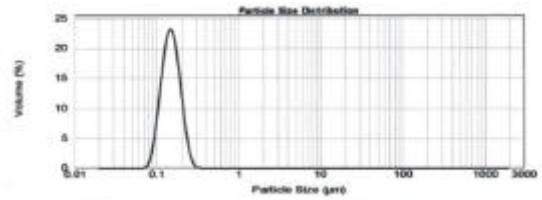
The primary advantage of seeded jell alumina or polycrystalline alumina is that it can be produced in a very fine particle size with very narrow particle size distributions. This is particularly important for polishing, especially for polishing softer metals or materials which have inclusions (e.g. copper, certain steels and aluminum).

Other advantages of seeded jell processing is that the harder alpha crystal particle can be produced in the submicron particle size, and thus has higher durability and performance as compared to calcined gamma alumina. The seeded jell alumina particle is also a polycrystalline particle and thus has a greater number of smaller cutting points as opposed to the flat platlety particles formed during the calcining process.

Continued on page 2



0.05 um Calcined gamma alumina



0.20 um seeded jell alpha alumina

Inside this issue:

Considerations for proper Alumina polishing

- Particle size distribution
- Polishing solution chemistry
- Reactivity of specimen at either low or high pH values
- Proper selection of the polishing pad

Seeded Jell Alumina Continued

Continued from page 1

The processing of seeded jell alumina is accomplished by properly controlling the solution pH and electrochemistry of the solution. Thus the polycrystalline acidic Nanometer alumina polish is processed at a low pH value of 4 and the basic or standard Nanometer alumina is processed at a pH of 10. At these pH values, the surface chemistry of the alumina particles is optimized for minimizing particle agglomeration, thus producing a much smaller and tighter particle size distribution.

Calcined Alumina

Calcined alumina powders have been the traditional final polishing abrasive for many years and is relatively inexpensive and readily available. The issue with the calcined powders is the agglomeration issue created by processing this type of alumina, as dry powders create particle agglomeration. For larger particles (>600 grit), the agglomeration is less significant, however for smaller particles agglomeration can a problem. For example, the agglomerated or standard version of a 0.05 um aluimina crystal can form an agglomerate size as large as 40 um. When polishing hard samples these agglomerates can often be broken down, however for soft materials such as aluminum, copper, zinc, etc. these fine agglomerated abrasives can form large random scratches.

Agglomerated vs. Deagglomerated

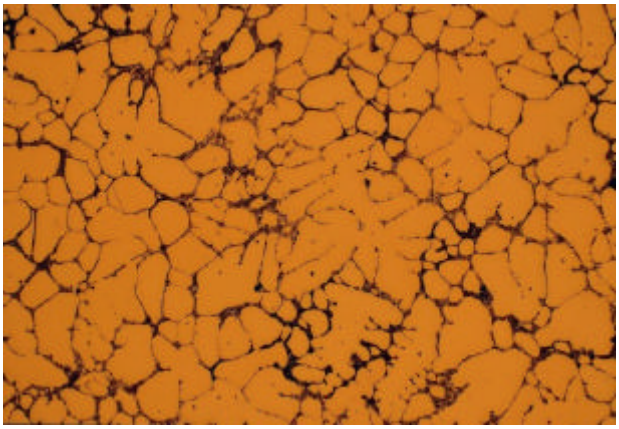
The term agglomeration refers to the electrostatic attraction of small particles to each other. This arises from the fact that all surfaces have an unbalanced surface charge. For small particles, the surface area of the alumina particles becomes relatively large compared to their volume, thus surface charge and agglomeration forces take over causing agglomeration. This is particularly true for alumina's such as calcined alumina which are processed in the dry condition.

The term deagglomeration refers to the process by which dry agglomerated particles are milled or broken down. The process for deagglomeration of dry powders is to blast the agglomerated powder at each other at high velocities, thus breaking down the agglomerate size. Note this deagglomeration process is only moderately successful.

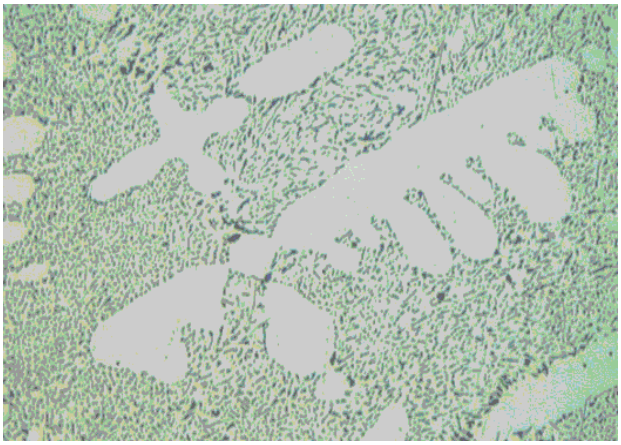
CMP (chemical mechanical polishing)

Nanometer alumina polishes are available in either a low pH 4 or a high pH 10 slurry; therefore, they make ideal CMP polishes. The goal of CMP polishing is to match the chemical dissolution of the sample with its mechanical abrasion. The result is the ability to remove the damaged layer both mechanically and chemically. CMP polishing is particularly useful for hard to polish samples such as niobium, tin solders, zinc and other hard to polish specimens.

To enhance the chemical effects of the polish, a light or less reactive chemical etchant can be used. The results can be very surprising.



Polishing of copper alloy with Nanometer alumina



Polishing of aluminum-silicon alloy with Nanometer alumina

"Seeded jell alumina abrasives are one of the most significant polishing abrasive advances over the last 50 years."

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