LATTICEGEAR

Customer Success Story

LatticeAx® in Action: Dry, Particle-Free Wafer Downsizing in the Cleanroom

Learn how you can downsize wafers and prepare samples in the cleanroom—without compromising the cleanliness of the cleanroom or wafers. In this paper, we use the LatticeAx 420 scribeless cleaving system to cleave, then we measure the particle contribution of the LatticeAx cleaving process.

Users of nanofabrication facilities often need to prepare multiple samples from a single wafer or piece of wafer for parallel processing and other experiments and analysis. Downsizing wafers into coupons saves cost (reduced lost wafer material) and shortens process development time relative to running a single experiment on a whole wafer. Because it is not practical for wafers to leave the cleanroom, samples are prepared in the cleanroom by dicing saw or cleaving. The concern however, is that while cleaving is a dry process and also the least destructive method, it does produce particles which can contaminate the sample and the cleanroom. The cleaving process – commonly performed by scribing the wafer surface with a diamond scribe, then breaking the wafer by hand or using a ruler or pin for leverage – will create particulate contamination. It is critical to develop a process to prepare samples in the cleanroom that does not compromise cleanliness. And by developing a successful sample preparation method for the cleanroom, the risk that wafers will be contaminated, lost or broken if removed is eliminated.

In partnership with major nanofabs, LatticeGear has determined that cleaving can be "clean" by using the LatticeAx microline indent[1] and cleave system.

Here is what the manager of a national nanofabrication facility said:

"…Our needs for the 420 (LatticeAx) were based on the high number of users downsizing wafers (cleaving small pieces of wafer by hand) while in the fab, before moving samples to major process tools and or wet chemistry. Although we have many policies in place against doing this, they are difficult to enforce. Our costs to keep and maintain cleanliness are high and the only way to drive a change was to offer the user a way to cleanly cleave their wafers in the fab. We implemented a solution and they were glad to use it. Since acquiring the LatticeAx 420, we notice a significant reduction in particulate contamination, as most users have shifted to cleaving with this tool, so clearly there was a real need for this tool. Many users make multiple pieces from a single or partial wafer, so repetitive cleaving is also quite common)…"

[1]Microline indent is a scribeless process unique to LatticeGear and the LatticeAx Cleaving System

Here at our nanofabrication facility, we found that after installing the micro-indent [LatticeAx 420] in our cleanroom, users are no longer cleaving samples in the lithography area. Additionally, the "cleaner" cleaving process of the micro-indent creates very few shards and particles that are easily vacuumed. Users are motivated by the capabilities of the LatticeAx and rewarded with a cleaner process. It's a win-win scenario"

Operations Director
National Nanofabrication Facility

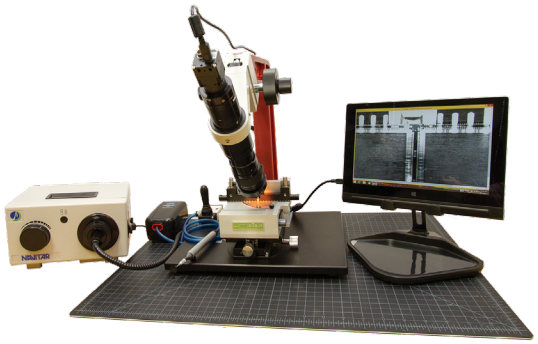

Figure 1. LatticeAx 420 Cleaving System on 18" (46cm) cleaving mat.

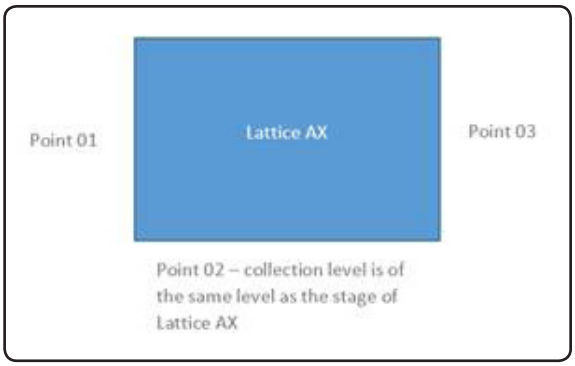

Figure 2. Locations of collection points relative to the LatticeAx.

There are several challenges to keeping the nanofab clean:

- High number of users (in the hundreds);
- Users are researchers, not sample preparation experts;
- Scribing and cleaving is mainly a manual process using scribers. Success is user dependent and can produce a few or a lot of particles;
- The nanofab users are not "invested" in the facilities. They come and go;
- The nanofab doesn't have many avenues for cost reduction and it struggles to maintain costs within budget.

There are numerous benefits to "clean" wafer downsizing:

- Reduced particulate contamination;
- Less damage to the samples, more accurate results. This is especially important for surface analysis preparation, e-beam lithography, photonics, and a wide variety of electronic applications;
- Reduced cost: with less need to repeat experiments, there is less scrap;
- In comparison to dicing, it is dry, performed at room temperature and is gentle to the wafer.

How does the LatticeAx address these issues?

- The LatticeAx includes both the weak point creation (microline indent) and the cleaving step in one tool. As a scribeless cleaving process, it doesn't generate particles and is therefore, the best cleaving option available for a cleanroom. By eliminating hand scribing and cleaving, the LatticeAx reduces particulate contamination and cleanroom decontamination costs;
- The LatticeAx wafer downsizing process is always the same and does not depend on user expertise or luck. This is very important for those researchers who wish to rapidly advance their research by eliminating risk to their unique wafers and samples;
- The LatticeAx indent and cleave process impacts only the edge of the wafer (<1-mm), without touching the surface or the cross sections. This approach eliminates contamination, and leaves the structures and films intact.
- The LatticeAx is a dry, room temperature and gentle method and can handle small samples as well, which is usually the biggest challenge.

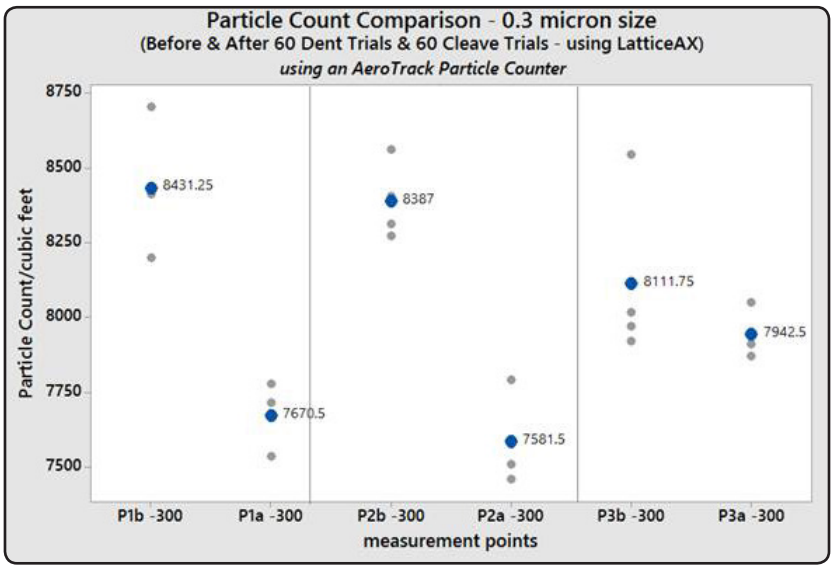

Figure 3. Particle count comparison for 0.3 micron size, before and after wafer cleaving, points 1-3.

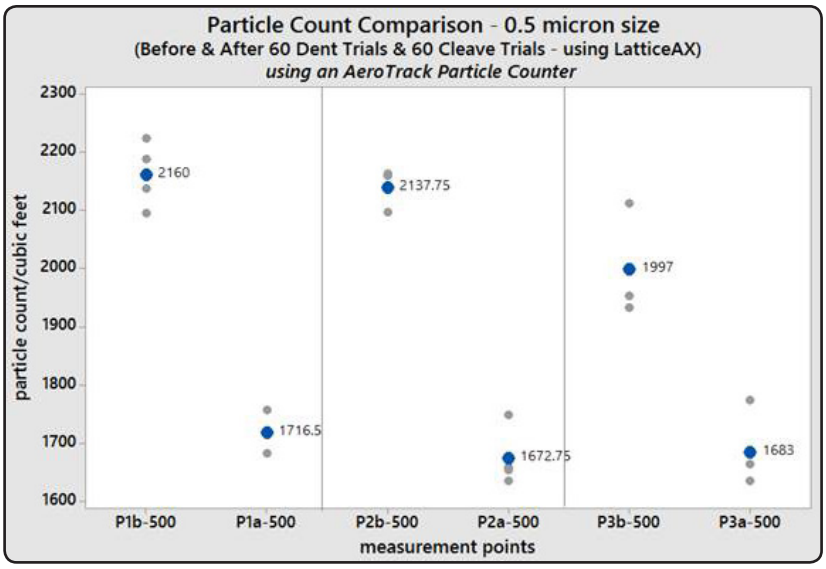

Figure 4. Particle count comparison for 0.5 micron size, before and after wafer cleaving, points 1-3.

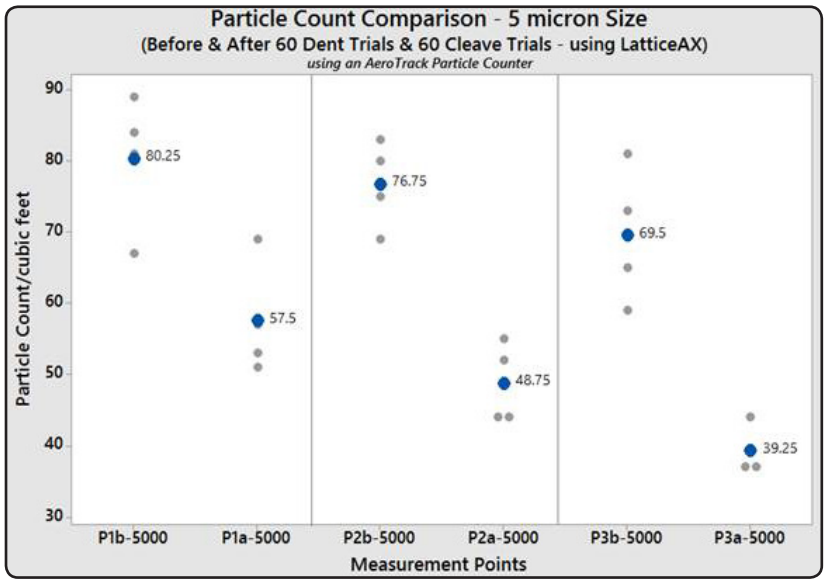

Figure 5. Particle count comparison for 5.0 micron size, before and after wafer cleaving, points 1-3.

*Pump speed is a relative value between 0 and 255. Zero is the lowest speed and 255 is the highest speed.

Quantification of LatticeAx particle contribution to cleanroom

To quantify the particles generated during wafer downsizing using the LatticeAx 420, data was collected after the full process, from sample handling to cleaved wafer piece. Results showed no increase in measured particles in the vicinity of the LatticeAx 420 (Figure 1). Note that the particle count was relatively high because the test was conducted in a non particle-controlled environment.

Experiment

The particle count was undertaken to determine whether the LatticeAx 420 cleaving system could be installed in the cleanroom without impacting particle count. To obtain statistics, 60 samples were cleaved out of 10 whole, 4" silicon wafers. The results showed no increase in particle count. Particle counts were less after cleaving because the sample point was constant. Most of the particles were consumed by the counter on the first trial and then each succeeding trial.

Experimental procedure

Measurements were made using an AeroTrack Pro 9303 particle counting tool.

The tool was fully charged; this is essential for stability of pump power and a reliable particle count. Once charged, the counter was turned ON and the laser stabilized for approximately 15 minutes. Zero check was done prior to particle count analysis to determine if the sensors were accurate. This was done for three, five-minute cycles. A HEPA filter attached on the particle inlet was used for this test.

Tool Parameters used: Pump speed*: 135; measurements per point: 4 trials per location.

Figure 2 shows the measurement locations relative to the LatticeAx (Figure 1). Particle collection duration was 1 minute per trial. Before and after results are reported for 0.3, 0.5 and 5.0 micron particle sizes (Figures 3-5).

Results

For all three particle sizes collected, no additional particles were added as a result of the LatticeAx cleaving process. Measurements after cleaving were always lower than before cleaving.

Summary

Reducing cycle time and cost while developing the best processes is critical in creating new materials and products. Optimizing something as basic as sample preparation of wafer coupons can help to streamline the workflow and achieve these goals. To qualify the LatticeAx 420 as a "safe" tool for the cleanroom, particle measurements were collected. Results showed no additional particles were added as a result of the LatticeAx cleaving process, which validates the LatticeAx a cleanroom-safe cleaving solution that helps reduce costs for maintaining cleanliness.

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Learn more about the LatticeAx 420 Scribeless Cleaving System

https://latticegear.com/products/latticeax/latticeax-420/

Receive the publication:

Email lg@latticegear.com with 420 in the Fab as your subject line and we will send you a PDF copy of the article.

About LatticeGear, LLC.

Company founders Janet and Efrat, two women with extensive applications experience in the semiconductor industry, believe that scribing and cleaving can be accurate, repeatable, easy and fast.

They started LatticeGear in 2012 to provide solutions and resources that help technicians, engineers and researchers increase throughput and productivity for their sample preparation workflows.

From kits that take the guesswork out of selecting supplies for a specific use case, to compact desktop scribing and cleaving machines designed for speed, ease of use and high quality results, LatticeGear solutions are helping to alleviate sample preparation challenges in materials research and failure analysis labs around the world.

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