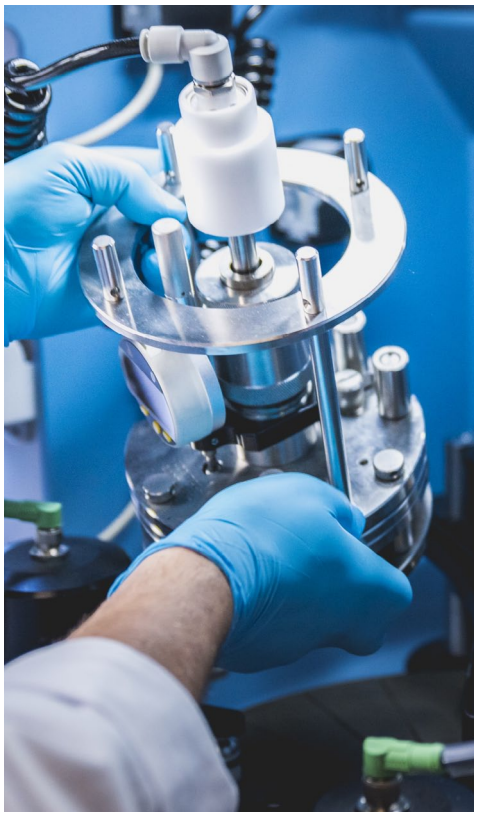
APPLICATION NOTE | Logitech Ltd.

Gallium Arsenide Wafer Processing: LP70

INTRODUCTION



In wafer end fabrication, lapping and polishing processes have become more predictable, but there is often the need for a significant level of user expertise, guesswork and development time in order to optimise surface finish and repeatability. These are key constraints researchers and manufacturers face within a quick moving market, which strives to reduce operating costs at any given opportunity – driven by volume and yield. The lapping and polishing of wafers used to manufacture semiconductors and optical devices is a time consuming task that can risk damage to expensive custom wafers if things do not go to plan. To tackle these constraints, Logitech has introduced automated processes, improving productivity and increasing repeatability by approximately 40% compared to non-automated techniques.

The LP70 multi-station, precision lapping & polishing system offers a semi-automated processing platform that allows operators to achieve stable, accurate and repeatable results while maintaining high levels of process stability across almost all substrate materials.

Materials commonly used in semiconductor applications are ranked using a scale of hardness, the Mohs Hardness Scale. The hardness of the material determines the process parameters, accessories and consumables required to successfully process the wafer material to the desired target end point specifications. Materials ranked lower in the scaled are typically soft, fragile and difficult to process. When processing these materials a high level of control and repeatability are required to maximise process yield.

WAFER THINNING

The LP70 offers the high levels of control and repeatability required for the thinning of fragile semiconductor wafers without risk of breakage or damage.

Gallium Arsenide (GaAs) rates 3.5 on the Mohs Hardness Scale, its crystal is softer and more fragile than traditional semiconductor wafers such as Silicon, and therefore great consideration must go in to the manufacturing process. Optimum productivity and quality is achievable by focusing on process control. Preston's Law provides a framework for predicting the amount of material that will be removed in a given time by lapping and polishing processes. By controlling variables using automated precision lapping and polishing systems with high levels of user control, operator variability can be minimised while process accuracy and greater repeatability can be achieved.

Every semiconductor wafer goes through several customised processing stages during manufacture, including slicing the wafer from its crystal ingot, preparing the surface prior to fabrication and subsequent thinning of the wafer through lapping and polishing techniques.

After slicing, wafers are lapped to remove surface damage that occurs during the cutting process. During lapping wafer flatness is improved while micro-roughness is also reduced. Chemical mechanical polishing is the final material removal step, allowing for the attainment of super-flat, mirror-like surfaces with a remaining roughness on an atomic scale.

GaAs LAPPING TRIALS

Lapping trials were undertaken on the LP70 multi-station, precision lapping & polishing system using 3" GaAs wafers. The lapping and polishing data for the LP70 was compared to older, less automated machines to determine the advantages of processing using a more automated and highly controllable system.

The lapping process was conduced using an abrasive slurry with tightly controlled particle size distribution with high purity. A slurry with finer particles is favoured for this fragile material to provide the optimum balance between material removal speed and maintaining the integrity of the underlying GaAs wafer. The wafer was processed at varying speeds from 10-30rpm, comparing to the LP50 process that was undertaken from 10-30rpm. These trials showed a typical 30% increase in removal rate on the new LP70 compared to the LP50.

The LP70 comes with four workstations as standard, in comparison to three standard workstations on the LP50. This allows the process of up to four 100mm/4" wafers or two 150mm/6" wafers at one time. In these trials our process development engineers focused on measuring the variability of results between each workstation (jig to jig variation). The data from the process trials showed a significant reduction in jig to jig removal rate variability from 17%, on the non automated machine, to 5.6% on the new LP70 machine. This data proves operators can confidently process up to four samples simultaneously while maintaining an even MRR across each samples, substantially boosting productivity.

The LP70 has the ability to chart the removal rate data from the process jig and auto-plate flatness monitor in real-time utilising the time weighted average (TWA) functionality. The real time data feedback function allows user to accurately control process events, such as stopping the process or programming a new action when a target removal has been reached. This includes the interaction of the process variables such as plate speed, slurry flow rate etc. This allows for highly accurate and repeatable processes. Data averaging is used to 'smooth' the process noise for increased accuracy on the target removal, using the central limit theorem. The amount of averaging is listed as a user control input field in the software, so the operator can optimise their process depending on process parameters and process consumables. Removal rate data can be plotted in real-time on the LP70's graphical user interface (GUI); data can also be exported for further analysis via USB. This functionality allows operators to achieve increased levels of accuracy and automation within their process improving repeatability.

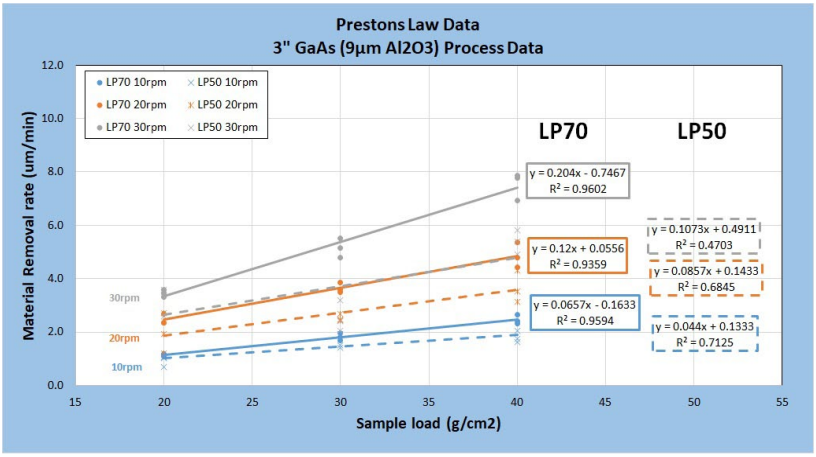
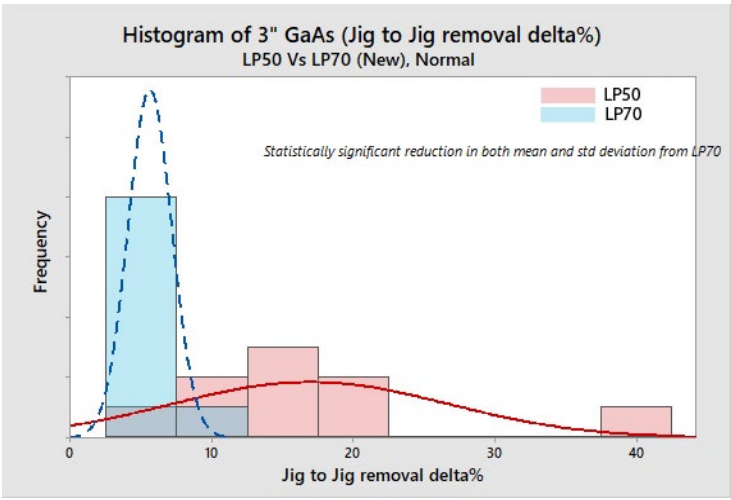


Figure 1: Comparative MRR data shows a >30% increase in removal rate from the LP50, directly from higher plate and jig speeds.

Figure 2: Jig to jig variability shows an improvement on the new LP70 machine in comparison to non automated machines



For more information regarding semiconductor wafer processing using the Logitech LP70 or other products in our range please visit our website or get in touch at:

enquiries@logitech.uk.com

Web: logitech.uk.com

Tel: +44(0)1389 875444

Email: enquiries@logitech.uk.com

LOGITECH
Materials Technologists & Engineers