SEMI Working Group Addresses Defectivity, Variability and Reliability

This is the second in a series of articles on the work of the newly formed SEMI Components, Instruments, and Subsystems (SCIS) Working Group

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The world of the next semiconductor technology innovation is strewn with the concepts of "collaboration, alignment, supply chain bottom to top, clearer definitions for variability, reliability, sources and consensus of measurements to achieve basic improvements." We have hardly made a dent in realizing these improvements and that, in essence, is the reason to bring all the contributing factions together to focus on simple steps or even one step forward to build the momentum and a template to deliver true progress.

In the last article, we discussed the fact that the industry may be realizing that the gaps DO exist and that the term collaboration currently contains a lot of "fluff" and is the most overused and under-demonstrated word in the industry. The intellectual property (IP) factors, real and projected, have always prohibited true collaboration. Moore's Law has driven our technology forward every 18 to 24 months, leaving little time to optimize, since "what works" is pushed forward to the next sub 10nm frontier until it does not work anymore. Deep knowledge resides with equipment, material and component suppliers who respond to the immediate challenges at hand. However, with a true platform for considered, pre-competitive collaboration, this knowledge can be applied by leveraging lessons learned and by accounting for interdependent systems delivering robust innovation from sub-system suppliers with effective routes for problem solving and cost reduction.

The SEMI Components, Instruments, and Subsystems (SCIS) Working Group was forged to find a forum that would allow creative discussion and solidify those paths needed for bottom-to-top alignments, and guide essential foundations for SEMI requirements. It is only now that all participants: sub-component manufacturers, OEMs, forums (SEMI and SEMATECH), and end-users, are actually using this task force to discuss and commit to key areas of alignment. With dedicated efforts, we may be able to craft badly-needed technological assets of hardware and application to meet the stringent requirement of sophisticated process innovation.

SCIS (SEMI Components, Instruments & Sub-systems) is helping to form new methodologies to view all information as true indicators of performance. There is a tremendous need to focus on the things that can be attributed to performance, but developing the right criteria must be explored by all parties and be relevant to the sub-component associated with those criteria. And with agreement from the users, OEM and end-user, those sets of criteria must be held to the methodologies appropriate for each subcomponent. These will differ for each sub-component but will be relevant to the family of sub-components and process conditions associated with them. The goal is to form guidelines that both build confidence in the parts used, and that can be measured against unique semiconductor requirements, since most of these components were indeed, never developed for this specialized industry.

With all the right stake-holders involved, SCIS will promote the type of progress needed to assure that hardware will not be the limiting factor in achieving the "below 10nm" footprint. This is a complex eco-system requiring specifications, agreed expectations, testing and innovations to support the industry's roadmap. With more than 20 years of successful pre-competitive collaboration, the device manufacturers have propelled this industry through rapid growth and prosperity. Extending this collaborative systems approach will enable the supply chain to more effectively exceed industry requirements.

Figure 1 demonstrates the ASTM measurements that determine data sheets on seals today. It is important to realize that most of these are actually less relevant to the industry requirements of particle generation or performance.

The issues of misconception and inappropriate specifications also exist in many other subcomponents. Pumps—essential to all vacuum systems—are in themselves subcomponents that are moving to higher standards of design (see Figures 2 and 3). Historically, vacuum performance has been measured in low pressures and up-time targets. Increasingly, integrated systems of vacuum and exhaust gas management can reduce utility consumption, reduce footprint, ensure up-time on new by-product heavy processes,

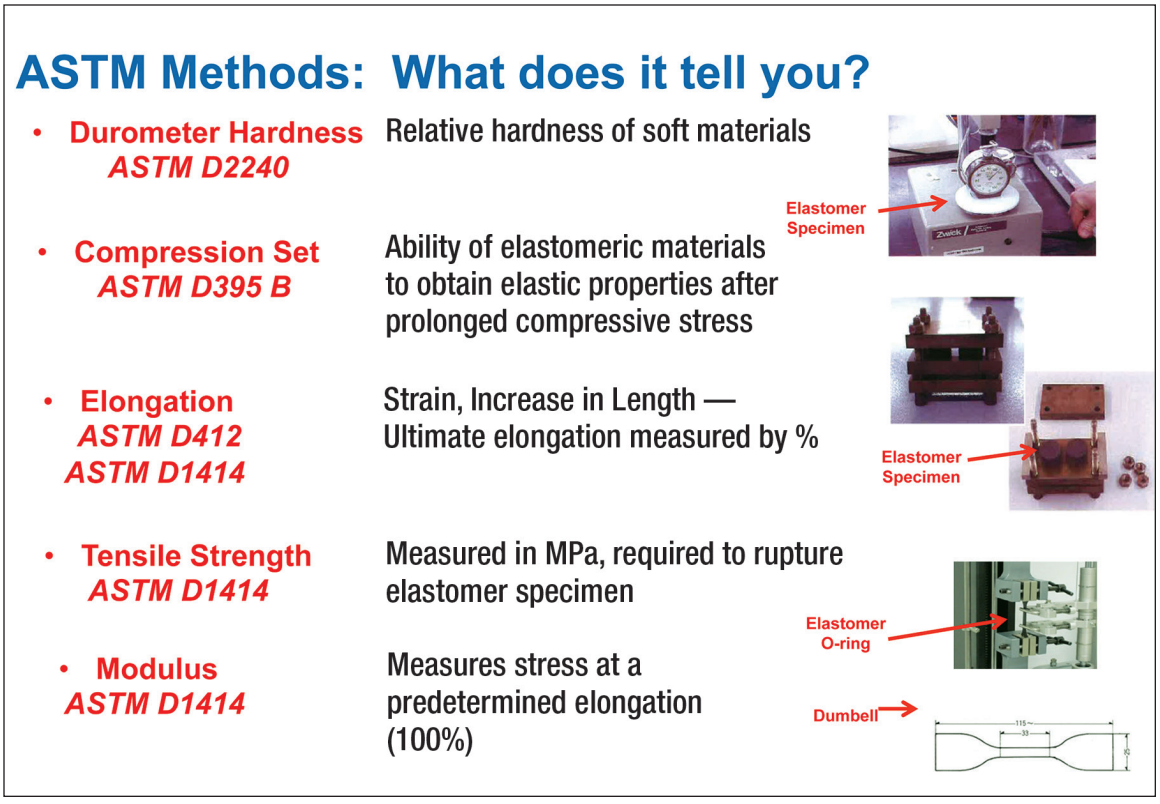

Figure 1. The ASTM measurements that determine data sheets on seals today.

monitor performance and provide predictive failure information.

Through the SCIS Working Group, Applied Seals is leading the effort to rewrite a SEMI Standard (SEMI F51: Guide for Elastometric Sealing Technology) so that the Standard can continue to be used for specifying sealing compounds and their applications. Due to the myriad of different chemical and physical properties of both seals and processes updating the standardized approach for specifying sealing compounds and seal configurations is needed. The mis-application of o-rings and seals creates significant costs and downtime." For more info, visit SEMI Standards, specifically the related SNARF[1] and Document.[2]

Closer collaboration with device manufacturers and other sub-suppliers will drive process risk reduction. As part of the vacuum system, pumps and abatement can be a source of particles but they also provide the primary force is removing process gases and by-products. Simple additional collaboration can assist in making cost-effective process decisions—such as in a process that generates a high level of by-products—as in the benefit at the chamber with additional purges or exhaust line heating downstream. Edwards can easily attest to maintenance and uptime trade-offs, but there might be process contamination benefits that are not systematically being applied.

Currently, system design is pulled from a variety of sources: OEM specifications, known field issues, and current best known methods. However, as specifications get more stringent it is critical that they are tied to value-added performance requirements in order to avoid unnecessary costs. Finite resources must be applied to the most

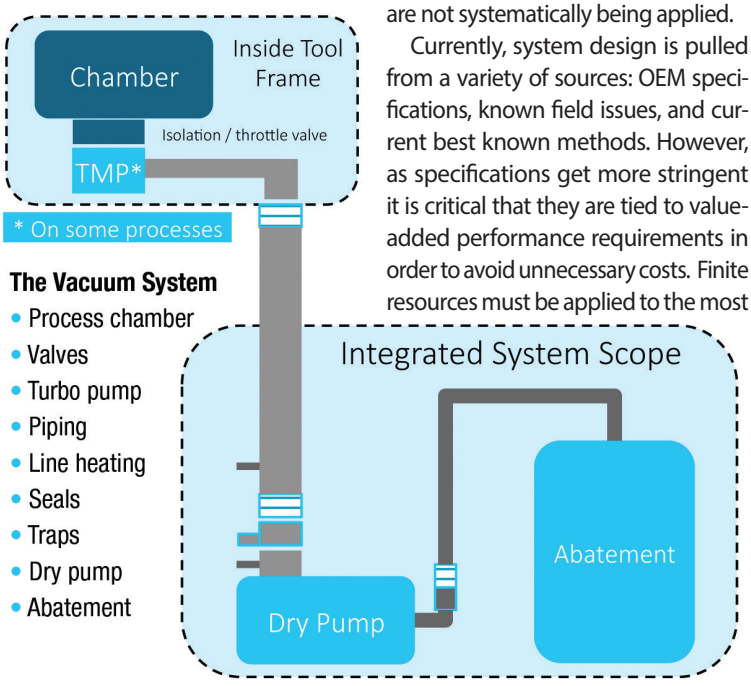

Figure 2. The vacuum system is all connected and includes multiple suppliers to deliver a high performance, contamination free environment

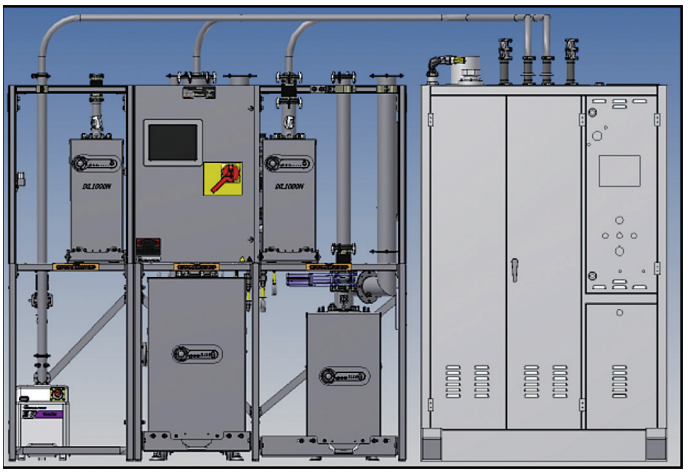

Figure 3. Edwards has focused on integrating the subfab vacuum and abatement systems to reduce footprint, installation time, interconnected piping and maintenance frequency by designing the system to address known performance and process-induced issues.

critical requirements and must anticipate technical direction, since lost opportunity in terms of timing and performance can be hugely costly. And while this may determine the success or failure of an individual supplier, the cost and loss is carried by the whole industry. Many mechanisms of by-product behavior and impact are tangentially collected. Pre-competitive collaboration would not only ensure that current best practices are employed but it can help identify the critical challenges to be considered for the next semiconductor manufacturing innovation.

SCIS provides a forum where suppliers can see the industry's challenges and targets in a context of priority and difficulty. It enables us to apply limited resources and time more effectively and provides opportunities to ensure better systems integration. Identifying what specific information is of key importance, such as pressure curves versus specific chemical formulations, can settle some of the IP concerns and propel us toward effective performance.

We have a unique opportunity to accelerate innovation, strengthen the supply chain and deliver the technology and cost targets for devices to come. G&I

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