

Advanced Delivery System Challenges

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The increasingly complex development of leading-edge semiconductors requires not only innovative, high-performance materials but also the right equipment offerings for an integrated solution to provide safe and reliable distribution, processing, and storage of these specialty chemicals and gases in the fabs.

The scope of delivery systems can be broadly considered to include ultra-high purity bulk gas systems installed outside the fab on the gas pad, and specialty gas and specialty precursor systems for cylinder or bulk containers, CMP slurry and post-clean distribution systems, and wet chemical and chemical blending systems each installed in the fab, sub-fab, or gas & chem rooms. There are also a wide range of systems and technologies related to material delivery such as containers, filtration (bulk, intermediate, and point-of-use), metrology (mobile, in-line), and abatement solutions.

Safety is the underpinning of all delivery systems. Safeguarding the materials to ensure the health and safety of personnel in the fab, sub-fab, and in the gas /chem rooms is mission one. That mission is accomplished through the use of properly-selected hardware and materials of construction, and further (i) by controlling the pressure, temperature, and flow of products, (ii) by monitoring for process excursions and interfacing with fab process safety and control systems, and (iii) by providing proper exhaust and ventilation capability connected to compatible exhaust and treatment systems.

Beyond safety, delivery systems must also be both reliable and cost-effective. Reliability can be quantified by on-stream metrics such as MTBF, MTBA and MTTR and by the systems' capability to maintain the critical material purity required in the fabrication process. Reliability can be advanced through the use of prognostics, diagnostics, preventive maintenance, and redundancy. Successful suppliers are able to meet all of these criteria in a cost-effective offering that goes beyond the initial system price and optimizes other cost factors such as operating costs, facilitation costs, operations labor, footprint, and ergonomics.

The leading edge of materials delivery presents challenges and opportunities for introducing enhanced capabilities within delivery systems, between the systems and the fab interface, and through integrated materials & delivery systems solutions. Four areas of advancement in next-generation delivery systems will be reviewed, including:

- (i) the Big Data Interface between systems-and-operators, systems-to-system, and system-to factory. Harnessing and processing data from these interfaces yields improvements in manufacturing operations.

(ii) extending the Automation of Delivery Systems & Processes. Today's delivery systems already incorporate automation, for example: to provide for uninterrupted supply of product during container change-out, and for certain purging and analytical sequences. Next-generation systems will evolve to offer greater degrees of automation, reducing operator-interface, and to provide predictive diagnostics of operating problems and maintenance prognostics with automated service scheduling and parts specification and ordering.

(iii) expanding the scale and capabilities of delivery systems to accommodate ultra-high volume and ultra-high flow fab supply requirements

(iv) effectively delivering solid source materials and highly energetic materials

The delivery system ecosystem is not static, as suppliers continuously work toward developing and evolving their product lines to address these leading-edge delivery system opportunities.