High Tech Fire-Safe PVC Materials Used to Make Semiconductor Wet Bench Processing Systems Ensure Quality and Chip Safety

VYCOM
OLEFIN AND PVC SOLUTIONS

Since all things electronic in our modern world are founded on semiconductor integrated circuit technology, it's not surprising that satellite businesses or support services have arisen and thrived around the precise science of manufacturing semiconductor chips or wafers. One such company, MEI of Albany, Oregon, actually builds the semiconductor wet bench processing "tools," often the size of a greyhound bus, that enable several of the multi-step processes involved in semiconductor manufacturing.

"Our customers use our equipment for the cleaning, etching, and developing processes required to make Silicon and Gallium Arsenide wafers for integrated circuits and micro-electromechanical (MEMS) devices. These devices, such as memory chips, analog chips, micro controllers and accelerometers, among many other applications, account for the majority of the semiconductor market segment," said Bill McGinty, MEI's Operations Manager. Just as important as the design and construction of these wet processing systems are the PVC materials that go into them—with their own set of performance properties that improve the end result and provide processing benefits to the OEM or end-user chip fabrication facility known as a fab.

MEI also develops their own process control equipment and automation software in addition to providing field service, repair, and retrofits on used equipment. "MEI is unique in that we manufacture equipment for customers tailored for their specific process, with integrated advanced process controls," said McGinty. "We have wet bench system platforms designed with core capabilities and general processes in mind, but in the final design and build out, the materials, modules, components and hardware sets are customized for each customer." Although MEI builds wet bench systems for other industries, the company has become a specialist in semiconductor and solar equipment, focused on automated batch immersion process tools for wafers and materials and semi automated wet benches.

With current semiconductor and solar forecasts, it's no surprise that MEI has honed in on wet bench tools. It is apparent that their wagon is hitched to a rising star, as semiconductor manufacturing is one of the top export industries in the U.S., with about 50% of the world market share. The World Semiconductor Trade Statistics organization forecasts 2.6 percent growth in world semiconductor sales to $310 billion in 2012 and 5.8 percent growth in 2013 to take the chip market to $328 billion. As MEI's expertise in building this semiconductor processing equipment has grown, so has their use of high-tech PVC materials and techniques that are conducive to the production of quality semiconductor wafers.

VYCOM
OLEFIN AND PVC SOLUTIONS

MEI uses Flametec PVC-C from Vycom, a fire-retardant, chemical and moisture-resistant material that is used to the build many facets of these large wet benches. The housing (or shell) of the wet process systems, the robotic arm ends, the chemical rinse tanks and conveyances for automated dry-to-dry wet bench acid process immersion tools are often made with Flametec PVC-C. For many of MEI's automated wet bench immersion tools, the wafers go in dry, are moved by robotic arms through the various chemical and rinse tanks then dried in an IPA style dryer. This entire chemical wet process can be very punishing to the equipment and the internal components of construction. PVC-C provides many advantages in this harsh environment. An inherently clean material, PVC-C is resistant to bacteria, reducing the possibility of contamination. It's also very low-maintenance and easy to clean. It is abrasion resistant, reducing particles created from internal components rubbing together, which can lead to contamination of the wafer bath as well as the reverse—corrosion or contamination of tool components from the chemicals. The properties of the PVC-C prevent both of these scenarios during chemically harsh wet bench processing.

Another important reason MEI chooses Flametec PVC-C, is their ANSI FM-4910 compliance, a designation given to a material that passes the Factory Mutual test for fire propagation and smoke density. Contamination from smoke particulates and toxicity can cause damage to the chips and threaten worker safety "We do use some non-4910 material called Protec for tanks and valve boxes, but for the bulk of our batch immersion wet benches for acid type process we rely on PVC-C,"said McGinty.

To build their automated wet processing systems housings and tanks, MEI starts with 5X8 and 5X10 PVC-C sheets, using multiple CNC router tables up to 10 feet long to cut and shape them. "We use a 3D CAD design program called SolidWorks, which posts through MasterCam directly to the CNC machine tools," said McGinty. Using tens of thousands of pounds of raw material each year, MEI finds having a PVC-C stocking program with Vycom's distributors very meaningful. "We rely on our supply chain to inventory and stock products for us," he noted.

McGinty says he's seen a noticeable improvement in the raw materials used for wet bench construction materials in his seven years with MEI. "Some of the older materials were brittle, difficult to weld, and had color match problems," he said. He notes workability has greatly improved with the PVC-C they are using. "Thermoplastic welding is essential to building these wet benches, he said, "the welds have to be strong and precise to prevent leaks and contamination."

Just to give a sense of how essential the welding techniques and welded materials themselves are to building this equipment, McGinty says MEI has plastic welding apprentice programs that take up to a year to complete. "It's as much a science as it is an art--there is very specific criteria to become a welder of these types of materials," he said. "It's all about timing, technique, pressure and getting the right angle –all of these skills are required to be a good PVC welder." McGinty says the apprentice welders start out on scrap, welding the material using different pressure, speed, temperature and angles. Only after about a year of training is the welder allowed to tackle the wet plenum, which is the most demanding and sensitive part of the large wet bench tool to weld quality. As secondary containment, the plenum is the tank area below the tool, which drains process chemicals and pure water used to rinse the semiconductor wafers.

With strong industry and process knowledge, outstanding design and modeling, and the right manufacturing tools and materials, as well as skilled craftspeople, MEI continues to grow with the semiconductor and solar industries. "This is one of the most material-sensitive industries that I am aware of," said McGinty. "Because PVC-C meets fire-safe compliance standards, is machinable, relatively easy to fabricate, and stands up to punishing environments, these materials allow us to create an end product designed to keep the semiconductor process moving," he said. "In silicon and compound semiconductor equipment manufacturing, it's all about speed, cleanliness, quality and repeatability and any disruption to those processes is very costly." In final production the exact configuration and process design of each wet processing system is kept proprietary to the customer. "It is closely guarded information," noted McGinty. Not surprising, in an industry poised to grow exponentially in the next two to three years.

FLAMETEC