Solid State TECHNOLOGY

EDITORIAL: Software: Key to the future of semiconductor processing

Software has long been a step-child of semiconductor fabrication. Toolmakers often tack on proprietary programs to help customers operate their tools and gather process data. Fabs may require interfaces, or even reprogramming, to enable a tool to link to their own software and perhaps a data network. While there are some interface standards, there is wide latitude on what software is written for different process tools, metrology, robotics, inter-bay automation, data acquisition, and other devices.

Lack of adherence to standards is also a common problem. Collaboration on standardizing key pieces of software, such as a standardized graphical user interface (GUI) (see "The emerging GUI standard," *SST*. June 1999, page 184), helps some, but patching different types of software together to operate a total fab is far from a seamless project. Still, there is no grand scheme in evidence to coordinate all these software efforts to smooth the way toward much more automated and better controlled processing plants.

One reason is that fabs have historically been run as islands — isolated operations. While lithography has to interface with a wafer track for applying and exposing resists, what need is there for a link to ion implantation? Considerable process and wafer metrology data may be gathered at each station, but only recently have fabs begun to try to analyze this data globally across multiple operations in the fab. Relating what happens in one part of the process to later or earlier steps is often infernally difficult, if not impossible, partly because of the huge volume of data collected but also because of software incompatibilities.

Some fabs have at least begun to address data collection and access issues to allow more global analysis of the interaction of various steps in processing a wafer. For example, could a thinner film in some parts of the wafer combined with some variation in later CMP, even though both variations are within tolerance limits, lead to differences in dielectric capacitance in later layers, causing unacceptable delays in that portion of the circuitry?

One reason for the free-form software in the industry may be that Semi's charter prevents the organization from setting standards for the industry. All Semi can do is act as a facilitator, enrolling interested parties in various software standards groups and taking care of the administrative work to help the process along. Some excellent work has emerged from such groups, particularly in the area of interfaces (such as SECS, GEM), mainly because of the hard, persistent work of dedicated individuals. But the larger problem of coordinating software across an entire industry is no easy task.

Texas Instruments made an attempt to coordinate the software efforts of toolmakers, getting them all to use the same object-oriented software, but again with little success. There are some commercial packages used in fabs — sometimes with help from Sematech — to integrate the software into fab management functions, but these are fragmented projects. Certainly, standards should not be set that cut off the potential for new software concepts or improved methods; to avoid this, well-defined

interfaces and links can allow flexibility in implementation. In other fields, open architecture approaches allowing easy intermingling of software and hardware have eventually won out over proprietary designs. Object-oriented software that follows evolving standards can provide processor independence and standardized message passing even among packages written in different object-oriented languages.

As processing becomes much more complex, and more steps are integrated, software will play a key role in allowing fabs to improve processes, get up to yield more quickly and smoothly, and automate operations. As we enter the new millennium, the techniques of data mining (see "The Emerging Role for Data Mining," page 45) offer the potential to add more science to semiconductor processing — which still includes a little black art here and there. Shouldn't a blue-ribbon panel be set up to ensure that needed fab software will be available and will work compatibly across all fab operations?

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