

## Executive Interview: C. G. Shih, president of Wavetek Microelectronics

*A foundry with an interesting mix of III-V, speciality CMOS, GaN on Si and SAW processes*

**Q: Tell us about Wavetek: when and how your company was formed and your relationship to United Microelectronics Corporation (UMC).**

Wavetek is a member of UMC's New Business Group. To better serve the fast growing wireless market, UMC, in addition to its existing CMOS foundry business, decided to become a provider of GaAs foundry services by setting up a new company using its 6-in CMOS fab (Fab 6A) in October 2010. We initially set up a mini GaAs line within this fab and, through five years of dedicated effort, we built up a stable HBT/pHEMT business. Last year, we decided to acquire all of Fab 6A's fixed assets and silicon-based product lines from UMC in order to further streamline the fab's operations. Wavetek remains an independently operated company.



**Q: Describe Wavetek's business model and technology strategy. Are you a "pure play" foundry? Do you only offer compound semiconductor processes or silicon processes, too?**

We are a pure play foundry company, providing dedicated, flexible and competitive foundry services to global design houses and IDM partners. We offer advanced technologies for the broadest range of product applications, both in III-V compound semiconductor (i.e., RF/microwave devices and optoelectronic devices) and silicon CMOS specialty (i.e., embedded high voltage (eHV), SAW filter and GaN on Si) businesses.

**Q: What markets are you targeting? RF/microwave or others, such as optical or power electronics?**

For III-V compound semiconductors, we started with RF/microwave devices. We have established a state-of-the-art manufacturing facility in these areas to address the wireless communication market. Then, in 2015, we initiated optoelectronic device development in areas such as PIN photodetectors, VCSELs and monitor photo detectors for both short wavelength (GaAs based) and long wavelength (InP based). In 2015, we also kicked off SAW filter technology development. Currently, we have already started product qualification with key customers. In addition, we have inherited a GaN on Si power device technology from UMC that was developed in our 6-in fab over the past six years. This technology is currently running some small volume production with a strategic partner.

**Q: Wafer fabs seem to run best with high volume and a low mix of processes. However, the RF/microwave industry has historically spawned a large number of specialized process technologies to serve smaller, performance-driven applications. Are you addressing these lower volume market opportunities?**

To better serve the RF/microwave industry, we certainly need to consider serving performance-driven applications such as infrastructure and industrial. Typically, these applications allow for higher margins to cover

the increased costs associated with low volume production, since they cannot take advantage of mass economy of scale. I always believe in an 80/20 rule for maintaining a healthy business. At Wavetek, we pay attention to these lower volume market opportunities as well as the mainstream sectors.

**Q: Expanding on the last question, what process technologies do you have in production and under development?**

In the RF/microwave area, we have released a series of HBT and pHEMT technologies to address applications from 2G to 4.5G handsets and base stations, as well as Wi-Fi broadband connectivity, CATV, point-to-point communications and radar applications.

Currently, we have several key technologies under development to offer even higher RF performance. We will be the first in industry to release KrF stepper-defined 0.15  $\mu\text{m}$  E/D pHEMT technology (ED15), to offer a high throughput, low cost solution for future 5G cellular (millimeter wave), 40/100G optical communications and 5.8 GHz, 802.11ac integrated front-end module applications. This offering will break the throughput and cost barriers set by the traditional, e-beam defined 0.15  $\mu\text{m}$  gate technology. Our technology can also address the needs of millimeter wave MMIC applications.

In the HBT area, we are developing a next generation HBT platform (SH series) to offer high linearity, high power-added efficiency (PAE) and ruggedness for future handset multi-mode, multi-band (MMMB) applications. In addition, we plan to release a BiHEMT technology, which combines the SH HBT platform with our ED50 technology, targeting integrated MMMB applications.

**Q: What about the size and capacity of your wafer fabs, i.e., what diameter wafers are you running, and how many wafers per month can you produce?**

We are currently running 6-in GaAs-based wafers for production with a capacity of 3,000 wafers per month. This capacity will be expanded to 5,000 wafers per month by the end of 2016. We are also running 6-in Si-based wafers for production with a capacity of 29,000 wafers per month. This Si wafer capacity can be flexibly converted to GaAs capacity within 6 months, as needed.

**Q: Describe the process design kits (PDK) you provide designers and which design automation software tools you support.**

We provide detailed PDK in two parts: The layout-related design platform is Cadence based, such as Virtuoso (layout) or Assura (LVS and DRC). Simulation benches use ADS-based models and Momentum-based EM simulation.

**Q: Looking at the “pure play” compound semiconductor foundries, TriQuint exited the market several years ago, leaving WIN Semiconductors as the market leader. AWSC is a player in the high volume consumer space, and there are a handful of foundries that support high performance, lower volume processes and applications, such as RF GaN. We also see several mainland China companies entering the market. Where does Wavetek fit in this landscape, and what differentiates you from your competitors?**

We developed advanced GaAs-based RF/microwave technologies organically through our talented, internal R&D team. Leveraging UMC’s high volume production experience and advanced lithography technology, we can develop unique

technologies to differentiate ourselves from the competition, such as our ED15 technology development.

We do observe some Chinese companies entering this foundry market. However, technology development and the ability to implement these technologies into a high volume manufacturing environment require an experienced management/technical team and workforce to successfully execute. New entries into this market also need time to cultivate their business. I think Chinese competitors are still in catch-up mode.

**Q: Do you believe the market can generate the demand to fill all these compound semiconductor fabs — also considering the improving RF performance of silicon? Where do you see your future wafer volume coming from?**

To be a successful compound semiconductor fab, you need to be very flexible in providing needed technologies to fulfill market requirements. For instance, in addition to delivering HBT and pHEMT technologies, we also provide SAW filter, GaN on Si power device, optoelectronic and other CMOS HV technologies. We believe that in the next five years, III-V-based processes will still be the main workhorse for cellular handset, cellular infrastructure and integrated Wi-Fi FEM applications. These products will still be the volume driver for III-V fabs. However, we are

also paying attention to the SAW and BAW-based filter technologies as another volume driver.

**Q: To wrap up, please tell us about your background and the career path that led you to become the CEO of Wavetek.**

I began my career with Standard Microsystems and IBM in New York, performing high speed VLSI circuit design. I then returned to the University of Illinois at Urbana-Champaign, where in 1995, I earned a PhD degree in electrical and computer engineering, studying optoelectronics. I joined UMC in the same year, where I advanced from CPU design management to director of marketing, then to VP of USA/Europe sales and customer engineering and, finally, senior VP of the new business group. When UMC decided to enter the GaAs market in 2010, I was a great fit for the job.

Wavetek's 6-in fab has several great specialty technologies: CMOS eHV, GaN on Si for power transistors and SAW filters. Introducing GaAs RF and opto-electronics processes into our mix certainly further enriches our technology portfolio. This is a great fab with hundreds of very talented and experienced process, equipment, integration and manufacturing engineers. Moving forward, we will continue to bring in new services and technology solutions to best serve our customers' demanding requirements.

---

For more information about **Wavetek Microelectronics**, visit [their website](#).