Tech Center Memories

Scott Elliott April 2024

SAW Devices: I was hired in 1977 to lead a group to produce SAW resonators.
These were blocks of very pure quartz with thin metal “combs” or fingers on them spaced to produce acoustic waves in the 1 GHz range and reflect on themselves to make a very high-Q resonator. They allowed the Spokane division to make the world’s lowest phase-noise tunable signal generators.

A big challenge was packaging. They had to be mounted on a beryllium substrate and then baked and packaged in a vacuum to prevent resonant frequency drift. Rod Supple and Dave Thomasson developed a unique robot to do it.

We went on to develop other SAW devices such as Brick Wall filters on both quartz and lithium niobate that were used in the 8510 Network Analyzer and other instruments.

Yen Chu, Pete Planting, Scott Elliott, Michael Symmons, and Don Johnson

Millimeter Wave Devices and ICs: In the late 1980s, we were using Molecular Beam Epitaxy (MBE) to design materials with layers of a few atomic widths. It was called Planar-doped Barrier (PDB) technology and allowed us to make essentially zero-voltage (ideal) diodes. Such precise devices allowed us to make millimeter wave devices and integrated circuits such as mixers and very sharp rise pulses - used in many HP/Agilent/Keysight instruments. It was a great group including George Patterson, Mark Zurakowski, Domingo Figueredo, Bill Anklam, Susan Sloan, Mary Stone, Nina Hitchinson, Mimi Planting and others

Optical Devices: Also in the late ‘80s, we jumped on the high-speed fiber-optic trend by inventing and developing high-speed optical devices. Of note was a 10MHz to 26.5GHz (later 40 GHz) broadband integrated optical modulator, The technology was similar to SAW in that it was made of periodic metal patterns on blocks of Lithium Niobate over optical waveguides made by diffusing materials into the crystal surface. We published a HP Journal article entitled “DC to Daylight”. We also made 0 to 40 GHz optical detector diodes on GaAs with a transparent electrode. The group included Bob Bray, Roger Jungerman, Susan Sloan and others.

The Three-Inch GaAs Fab: I took over as Manufacturing Engineering Manager under Bill Lawson in about 1986. At that time we were still growing our own GaAs crystal boules in the basement and developing our circuits and devices on tiny (1") wafers or slivers of wafers using optical mask contact lithography. We knew that we needed to update our lab and made a pitch to our VP Bill Terry for money to build a new fab. We were given $30M, which would be about 50x short for a fab these days.

We almost made the decision to buy a fully-equipped GaAs fab from Ford Microelectronic in Colorado Springs instead, but we were worried about losing some of our key engineers who would not move out of SoCo.

I hired Neil Wyle to design the fab, and our facilities group led by Dave Shuffro led the construction. [Note: When I started as a new engineer in 1977, My desk was next to Dave Shuffro's and he chain-smoked cigars all day. (Yes, a lot of people smoked at work then). I bugged Dave about this and was ready to quit, but then Doug Gray moved me to George Henry's group away from the smokers. Later Dave thanked me for helping him quit smoking.]

To achieve the lithography for the constantly diminishing geometries for high speed devices, we needed an electron-beam writing machine. There were none commercially available yet, so HP Labs developed one with a group under Frank Ura (known as the Ura-nation.) This machine required a huge, solid concrete plinth to be built-up from the basement to the 1LS fab floor for stability, and then it was encased in double faraday-shield and magnetic shield walls, as any tiny field could warp the beam. When done, we could finally write gate lengths of less than half a micron.

Later, for optical devices, we needed to add a machine for OMVPE - Organo-metallic Vapor Phase Epitaxy. Organo-Metalic compounds are so deadly toxic that we had to dig down in front of building 1 and build a concrete vault. The vapor was brought in through double concentric pipes with sniffers mounted on the outer cylinder to trigger alarms. When I looked at a similar system at the HP Labs sister fab on Deer Creek Road in Palo Alto, they had a big red button in the OMVPE lab labeled "EVACUATE THE BAY AREA!" I was shocked until Kent Carey said "Oh don't worry, it means the area around the lab bay."

There were many innovations in the Fab those years. Many wafer processing steps changed from manual to automatic, with wafers moving from process to process in cassettes, and handled by robots through the processing machines. On the logistics front we wrote or adopted a program called SmartSheet that computerized the disposition and status of each wafer. With the help of three students in the Leaders for Manufacturing program at MIT, we were able to reduce the average lead time (start to finish) for a wafer from 4 months to six weeks. We were also the first group in HP to have self-directed work teams - teams that chose their own leader (more often than not, a technician rather than an engineer) - and organized their own operation.