June 14th, 2023

Here are some of my specific accomplishments in the science and technology sectors through the years.

1.) Hi-tech semiconductor technology transfer between the US and China in 2002 and 2003.
2.) Physics-based scientific measurement technique demonstrated 29 years ago on diamond: now being further investigated/developed by 5 companies which are striving to potentially produce a room-temperature quantum computer out of both the same technique and the same material set.
3.) One of The two key technology people in RFMD to work with Apple to spearhead, starting in 2011, the addition of a new style of communication chip (an antenna tuner) into the iPhone. In 2012 our company had placed one such chip in every iPhone 4s sold that year. And in 2019, when I left the company, there were 5 such chips in every iPhone. Tim Cook, the CEO of Apple, told my management, “We couldn’t make our phone without your chip”.
4.) Concerning the technology used for the iPhone antenna tuner, in 2013 and 2014 I took it upon myself to investigate one of the key fundamental limiting factors of the technology: silicon substrate harmonics. I collected the appropriate samples, took the data, generated the theory to analyze the data, analyzed it, and reported the severity of the limitation and how to understand it to my management. I involved no-one else, either within the company or outside of it. And it wasn’t even in my area of expertise. A large effort was implemented by the company to solve the problem, which still had no solution 5 years later when I left the company. I was given a promotion up two levels for my work.

Philip W Mason

1.) US-China High-Tech Semiconductor Technology Transfer, 2002/2003:

In my resume I list one of my responsibilities during my tenure in Allentown, PA, as being a technology transfer reliability expert. This specifically entails taking a manufacturing capability (in this case the technology used to manufacture high technology silicon chips) and copying it from an existing fab (fabrication facility) and get it running in a new fab. My particular responsibility and expertise was to provide reliability testing, data collection, data analysis, and verification that both, 1.) as one cross check that the processes had been transferred correctly into the new fab, and also 2.) more importantly that the new fab would produce reliable chips. Reliability refers to how long a chip will keep functioning in the field. It is a key piece of overall risk assessment, and the type of reliability I had expertise in (overall material wear out that every chip is subject to) is particularly critical due to the high exposure to litigation, were large numbers of field-failures to occur. Everyone wants their cell phone to run for at least a few years, if not much longer in their hands in the field. My specific role was to ensure the microscopic transistors (the main workhorse of all semiconductor chips) remained reliable during the transfer. There was also a coworker who ensured that the microscopic wires that connected all the transistors together were reliable, but the lion's share of the needed knowledge and testing and analysis capabilities fell on me. I also coordinated the move of the reliability testing lab (40 ft x 30 ft) room filled with rack after rack of highly sophisticated electronic test equipment from Orlando, FL to Allentown PA in August of 2002. This lab transfer was necessary because my company had made the decision to close or sell its fabs, and the existing technologies could be sold at a substantial price and almost pure profit. There were several companies with their own fabs that wanted to purchase our technology. I was not in any way shape or form involved in the negotiations. I was just a worker doing all the testing, analysis, and providing my own stamp of approval (which was all that was needed) to certify the technology was reliable in the new fab, and that all chips made using that technology would have sufficient reliability if they were designed using my reliability data. Of the information and knowledge necessary to certify the technology was reliable (Qualify it), 90% was undocumented due to the sheer volume of it. Therefore, retaining the employees within the company that were necessary to carry it out was paramount.

It was also during this time that the company had biweekly, if not weekly layoffs, and over the course of three years went from 17,000 employees down to 4500. The layoffs were necessary because the company had made the grave decision to become fabless, as I mentioned before. Due to the traumatic nature of such huge changes, there were at least 3 suicides that I am aware of, and one was by someone whose office was down the hall from me.

Now, to top it off, one of the companies investigating purchasing our technologies was Grace Semiconductor which had been founded in 2003 in Shanghai by two Chinese nationals, one the son of the former Chinese president Jiang Zemin Stepping back a bit in time, in June, 1997, I was hired by Bell Labs to work in Orlando, FL, supporting all their semiconductor manufacturing fabs for reliability. As a new hire, the company flew me to a welcome event at the headquarters in Murray Hill, NJ in October of 1997. As I was touring the facility there were red carpets rolled out everywhere. I was told that the day before the same Jiang Zemin, the then president of

China, had toured the facility and that they were for him and assured me that they were not for me ;-). He had been shown the Bell Labs technology facility as part of his trip to the United States at the invitation of President Clinton. At the time and for decades earlier, Bell Labs, part of Lucent Technologies, was the premier science and technology institution in the world. There were 8 Nobel Laureates in Physics that came out of Bell Labs.

Now, skipping ahead five years, I had moved from Orlando to Allentown and settled in with my family during the first two weeks of August, 2002 as had my reliability colleague responsible for certifying the reliability of the microscopic chip wiring. The technologies we transferred were quite advanced, but were not cutting edge. One of the primary differences was the microscopic wire material used. Our technology used the older aluminum material, which was pushed to its ultimate limits, but was still no match for the copper material that had started to be used by Intel and IBM at the time, and that was absolutely necessary to keep the technology advancing for the foreseeable future.

Now, remember that Chinese President Jiang Zemin who toured Murray Hill the day before me was the father of one of the two Chinese nationals that founded Grace Semiconductor in 2003. Perhaps coincidentally (or more likely not), according to court documents, Neil Bush, the brother of the then President George W Bush, and the son of the former President George H W Bush, signed a contract on Aug 15, 2002 with Grace Semiconductor for strategic consultation. Of course a very careful deal had been struck between the US and China regarding allowed high-tech semiconductor technology transfer, driven substantially by most of the listed elite powers, which in August of 2002 was of course carefully crafted negotiations around 9/11 which had occurred less than a year earlier. Of course I was not privy to them. ;-) I was just doing the work.

https://www.edn.com/grace-semiconductor-to-get-a-capital-infusion/

https://www.semiconductor-technology.com/contractors/electronics/gefdigital/#company-details

https://www.latimes.com/archives/la-xpm-2003-nov-27-na-neilbush27-story.html

2.) Physics based measurement technique being used to potentially develop a room temperature quantum computer.

The N-V pair (nitrogen-vacancy pair) atomic system in diamond has for the last two years been investigated by companies to potentially build quantum computers accessed using the PL-ODMR measurement technique that I first applied 29 years ago during my graduate school days at Lehigh University. Working with my thesis advisor, Professor George Watkins, and visiting researcher, Professor Helena Nazare, we unambiguously identified the “donor” atom as nitrogen, which had always been unclear. I presented a poster on the cutting edge results at the 1994 Gordon Conference in New Hampshire (poster T-10 on page C2 of the Gordon Conference summary document).

At this point there are five companies that are actively involved in developing materials (enhanced materials based on the diamond system we studied), measuring techniques (which are indeed based on the same PL-ODMR technique I used) and other components necessary to build a quantum computer, although they are holding most of their information close to their vests. Using this material, it might be possible to produce a quantum computer operating at room temperature. This would be a big game changer which would reduce the size of the computer, reduce the overall power consumption dramatically, and increase the attractiveness of the technology.

https://thequantuminsider.com/2022/03/31/5-quantum-computing-companies-working-with-nv-centre-in-diamond-technology/

https://pubmed.ncbi.nlm.nih.gov/9978680/

3.) Apple iPhone antenna tuner revolutionary chip and its reliability:

I was one of The two key technical people to work with Apple to spearhead, starting in 2011, the addition of a new style of communication chip (an antenna tuner) into the iPhone. In 2012 our company had successfully placed one such chip in every iPhone 4s sold that year, and in 2019, when I left the company, there were 5 such chips in every iPhone. Tim Cook, the CEO of Apple, told my management, “We couldn’t make our phone without your chip”.
Please note that I am not an expert on the engineering behind an antenna tuner, but learned a few things while at the company. The function of the chip was multiple: it could improve bandwidth (increase data rate) for a single antenna, or reduce battery consumption, or increase transmission distance to the cellphone tower, or a combination of the three. Alternatively it could reduce the number of antennas, saving space and complexity inside the phone. When using the antenna tuner to primarily increase transmission distance, you can sort of think of it this way: “By flipping in my(our) switch, you might go from two bars of signal service (indicated by the little signal icon) to three bars of service.” My specific role regarding spearheading the project was to provide the reliability expertise for providing the knowledge and methods to evaluate the predicted lifetime of the chip in the field and work very closely with the other key technology person spearheading the project to ensure his design would last for five to ten years. Note that one typically has six months to a year to determine whether a specific chip design will last for five or ten years in the field. This in essence involves being able to predict the future based on mathematical models. This is one of the key reasons why physicists end up as reliability experts in the high-tech semiconductor sector. It is also very important to get the predictions as accurate as possible due to the potential for phone field failures and immense litigation risk if they are wrong. And with more than 1 billion iPhones shipped annually, that entails a high degree of responsibility.

https://www.qorvo.com/applications/mobile-products/antenna-control-solutions

https://www.yolegroup.com/press-release/rf-front-end-module-industry-what-are-the-technical-choices-made-by-apple/

4.) Apple iPhone technology fundamental limitation: Silicon substrate harmonics.

Concerning the technology used for the iPhone antenna tuner, in 2013 and 2014 I took it upon myself to investigate one of the key fundamental limiting factors of the technology: silicon substrate harmonics. I collected the appropriate samples, took the data, generated the scientific theory to analyze the data, analyzed it, and reported the severity of the limitation and how to understand it to my management. I involved no-one else, either within the company or outside of it. And it wasn't even in my area of expertise (which was reliability, not electrical performance). In direct response, a large engineering effort was implemented by the company to solve the problem, which still had no solution 5 years later when I left the company. I was given a promotion up two levels for my work.