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Academics: Bachelors in Chemistry – St. Michaels Colleage, 1962, Graduate work in Physics, Bennington College, 1962-1964, MBA – Webester University -1991.

Work History:

1959-1969 ***Tansitor Electronics***, Bennington VT Research and Development Scientist

This work here was almost all R&D. There were a few key projects, developing a new capacitor for a Navy Program, improving the pyrolysis of $MnNO_3$ to $MnO_2$, (the active electrolyte), and figuring out the cause of aluminum corrosion which was causing pinholes in liquid filled cases. One early patent was, I think, one of the first thin film tantalum capacitors. Ta Thin Film It was used in hearing aids. I also worked on silver reclamation processing.

1959-1972 ***Data Strata***, Cedar Grove, NJ Processing Specialist

Here, the original intent was to develop tantalum capacitors for hybrid circuits, but the company switched gears, and I was put in charge of transferring processes to foreign countries. Our main client was NV Phillips, and I worked in Taiwan and Jamaica. This was not my cup of tea, so when I found the former Tansitor president moved to AVX, I called, and was hired there. A friend and I developed a light bulb extender for a different company. light bulb It was pretty trivial, but was the only patent where I personally collected royalties.

1972-2010 AVX ***Corporation***, Myrtle Beach, SC R&D Scientist to AVX Fellow

This is where the key part of my experience was. I stated in Olean NY, as an R&D Scientist, and then moved to their San Diego Filter operation with a project for **Raytheon**. After three years, I was back in Olean for a **Sandia** project, where my job was to improve an energy storage capacitor.(Then high energy was a joule per cc) This product required joining several parts, and is still being produced for Switch Mode Power supplies, seen here: AVX Caps

I then started a new line of Tantalum capacitors for them. When a new contract came for **Hughes Aircraft**, I was moved back to Olean to run that program, the purpose of that being to improve the reliability of the MLC chip. One of the techniques we developed was using thermal neutrons to detect internal flaws in ceramic structures. There are now better ways to peer inside the ceramic, but at the time it was fun to work with nuclear reactors.

Probably the most important product I developed was for **IBM**. This project spanned about 10 years, and consisted of negotiating a development contract, doing the basic development (in Arizona), and then after building workable prototypes, the moving of the project to Colorado and facilitating a dedicated building. The program became very successful, and in the late 80's was opened up to other customers. I then played a marketing role; creating product literature, giving talks, and visiting customers. On the last page is a copy of the product announcement IBM used. My product is the small brown parts in between the silicone chips. The part itself, about a mm square, contained four individual capacitors. The challenges were many, the major ones being the internal precision, ten times more than the then current MLC's, the requirement to withstand a high temperature reducing atmosphere, and the most difficultIt, using thin film C4 attachments on a thick film part. LICA

About that same time, I developed and set up a line for Thin-film terminated Single Layer Capacitors, which are still a current product. SLC Capacitors It is a version of these, the Maxi-Cap, that mimics the TC of the the EEStor material, but has low voltage breakdown. A 10 micron thickness would only withstand 10 or so volts.

After that, there was an interesting project with **Martin-Marietta**, to design and fabricate multi-layer ceramic actuators used in the deformable mirrors for Star-Wars. This was the first time I dealt with a product whose function was mainly mechanical. We spent about 3 years on the program, and had useful devices to spec, but the Star-Wars program was canceled. But the good part was we were relieved of the confidentiality, and allowed to make them commercially. I was again challenged to find a market for the product. I spent a year or two giving talks, and making samples for some customers, but it never really took off. That, plus the concern about the lead based dielectric, caused us to pull the plug. Here is the type of actuators we built, (these are not AVX's) Ceramic Actuators One of the interesting challenges in this part was the huge size of some of the prototypes. I made one for a submarine sonar that was a ring, five inches in diameter, and 1.5 inches thick.

In the early years of this decade, I worked on many different projects. We had a varistor product, which was made of doped Zinc Oxide, which had to be terminated with a difficult to solder Pd/Ag alloy. This was because the product could not be plated with ordinary means. Being semiconductive, normal electroplating would cover the whole product. We had been making varistors for years, in fact, AVX was the first, and a number of other competitors joined the fray. It was a lucrative product. However, no manufacturer could plate, they all had use the same difficult-to-solder termination. Even though I had never plated, I was challenged to figure it out, since that would really distinguish us, and give us a competitive advantage. After a few months, I hit upon a way to do it, and established a production process in the Raleigh plant. I was then sent to France, Israel, and England to install it for their lines. It is still being sold today. MLC Varistors. The process, with only slight variation, also worked with thermistors.

In the mid part of the decade, I became a fellow,(only the 4$^{th}$ in the company's 50 year history) and was allowed to pick most of my development areas. I decided that modules would be interesting, as it became obvious with my dissection of cellular phones, and discussions with Motorola and Ericsson, that modules were going to become important. We had some success with integrating passive components on a thick film process, but the complexity was limited, and the parameters of the components limited. I made some prototypes, but after a year or so, it did not look like we were going to be competitive, and the price of entry was too much for AVX at the time, There was one approach, detailed in patent 7006359 that was interesting, but I could not find a suitable means for the interconnect.

With a co-worker, we found a new way to terminate MLC's, and he set up a pilot line to work out the bugs. It took a couple years, but we got a number of patents on that process, which was based on electroless copper. Electroless plating of termination

In 2007 or so, I decided to go back to the tantalum world. We had a number of interesting customer requests for high energy devices, so that's what I concentrated on. We developed and qualified a high energy hermetically sealed wet tantalum that set a new standard. Tantalum High Energy There were two plants that I worked with, one in Biddeford, ME, and the other in the Czech Republic. There are 3 more patents on this product that have not yet been published. But to us, the range of 5-10 joules/cc was historic, but now miniscule compared to EESU projections.

One of the more profitable areas in the tantalum energy devices was for implantable defibrillators (the capacitor is shown at 30)

And, as you will see on the list of patents, there were a number of other devices that I developed. Many of them did not see commercial success, but I believe that most developers have that same experience. Sometimes something looks good as one starts, but other constraints arise. I had a nice project for Nokia, where they needed a ceramic version of a multi-channel RC filter. They were then using an expensive silicon version. It would sell for a couple dollars each, which is big money to passive folk. I created that part in record time, something like 6 months to send the customer samples. What was interesting, is that being familiar with the different processes in many AVX plants, I used processes from five different facilities to do it. But even during that time, the semiconductor version dropped to a quarter, which rendered the product unprofitable. It was disappointing, but still a fun experience.

Following is a live link to the Google system for a list of most of my patents. There were few before, and a few after those dates.

Please let me know what further information is needed .

Galvagni patents