

Dear Joshua,

In answer to your email of 9/27/02:

Intel originally introduced the Personal Computer. A Japanese company (Busicom) had designed a circuit for a calculator. Masatoshi Shima designed the circuit at Busicom. At Intel, Marcian "Ted" Hoff and Stan Mazor did the Logic work and Frederico Faggin added features. When they got done they realized the value of the design and purchased back the rights from Busicom. The device was introduced to the world in 1971 as the Intel 4004. The 4004 was a 4-bit processor but essentially equivalent to ENIAC – the first all-electronic computer which was built at the University of Pennsylvania while I was a student there in 1945,46 and 47. I had no part in it since I was a Chemistry major.

The following year in 1972 Intel introduced the 8008 which was an 8-bit microprocessor. In 1974 the 8080 was introduced and people began to make small computers with them – Apple, Sinclair, Radio Shack, etc. The 8080 was challenged by Motorola's 6800 device. Both companies charged about \$150 per device and lost money on each one because the yields were so poor.

The first large scale application for the microprocessor was the Atari Video Games. The price for a device was a problem, but there was an even bigger problem – the microprocessor had to run at a minimum speed of 1.5 megahertz and both the 6800 and the 8080 could only go to 1.0 megahertz. The solution came from a small company in Valley Forge, Pennsylvania named MOS Technology. The 6502 was made with a process designed for performance. I invented the process and it is patented. Not only could the 6502 go fast enough but it yielded so well we could sell it for \$15 and make a nice profit.

The existence of a cheap microprocessor opened the floodgates for applications. There were new game companies and many small computers made their debut. The processor usually was the 6502 from MOS Technology. The 6502 became the largest selling 8-bit microprocessor and held that honor for many years. Today the emphasis is on 16, 32 and even 64 bit processors. The 8-bit lives on in machine tools, toys (a big user) and industrial controls among other things.

I have made many “firsts” and some of them are used in nearly all Semiconductor Fabs al over the globe. Some of the firsts would include:

- 1. Report of the movement of dislocations in a solid crystal (1955)**
- 2. Design and build first semiconductor moisture sensor (1956)**
- 3. First report of Electrostatic Discharge Damage (1959)**
- 4. CVD glass surface protection of devices(1959)**
- 5. Designed grower to make perfect Germanium single crystals(1961)**
- 6. Plasma enhanced deposition of Silicon Nitride, Oxide, etc. (1962)**
- 7. Process for photolith on High Phos glass (1966)**
- 8. MTOS used low temperature Steam Oxidation (1966)**
- 9. Use of Positive Photoresist and see-thru masks ((1966)**
- 10. Metal Ion-free Developer for Positive Photoresist (1966)**
- 11. First MNOS devices (1967)**
- 12. First commercial I.C.'s with glassivation (1967)**
- 13. First LDD and Self-aligned Metal Gate Tetrode(1967)**
- 14. Coplamos with Semi and Full ROX (1968)**
- 15. Invented BPSG for reflow planarization (1974)**
- 16. Patented process for 6502(1974)**
- 17. Proposed CDROM to management (1976)**
- 18. Punchthrough Implant for higher voltage(1976)**
- 19. Developed process for CMOS 8-bit Processor1802 (1977)**
- 20. Gas Additive process for CVD to getter Hydrogen(1983)**
- 21. First commercial application of RTA (1984)**

You can go to any Semiconductor Fab in any country and you will find items 6,8,10,12,14,15,18,and 21 being used to make their devices. Without 10,13,14,15,18 and 21, the latest devices would not be possible. Of course there are a lot of other necessary factors in Optics, clean chemicals, clean rooms, etc. which were also needed to achieve today's excellent yields.I didn't make money for my contributions (some companies gave me \$1 and some gave me \$2 for a patent) but I have the satisfaction that the technology which I helped to develop is making possible devices to save lives and make transportation safer and improve our lives in many ways.

I hope this helps,

Lots of love, Poppop