SCOTT HINRICHS

Don Davis of *Gallium Arsenide News*

Arsenic and Old Chips

Gallium arsenide: technology for the post-nuclear age

Gallium Arsenide Valley? Today the name trips clumsily from the tongue, but a growing number of local corporations are betting it won't sound so strange in coming years.

The arsenic compound already plays a crucial role in President Reagan's "Star Wars" program and forms the basis for one of the few areas of semiconductor industry growth amidst the worst slump Silicon Valley has ever seen. As local companies compete for the growing pool of Pentagon dollars available for weapons systems, others are using gallium arsenide to meet the Japanese supercomputer challenge.

And while it represents a technology so fundamental and full of promise for the future that it just might replace silicon as the valley's most important chip-making material, critics fear the newest technical advance sweeping Silicon Valley may be its most dangerous yet.

Twenty-two Silicon Valley companies—including Hewlett-Packard, Fairchild, Varian, Avantek, Narda Microwave, Gould's Dexcel division, Harris Microwave Semiconductor and others—now produce gallium arsenide devices. They are supplied by 100 equipment and chemical companies, according to Don Davis, president of Horizon Associates, the Santa Clara-based publisher of *Gallium Arsenide News*.

Silicon Valley companies will account for 25 percent of the $1.5 billion world gallium arsenide market in 1985. While the gallium arsenide industry still toddles in its infancy compared to silicon-based semiconductor sales of $35 billion in 1985, the market is expected to grow to $15 billion by 1995, says Davis.

"This market is growing rapidly and is not affected by the current slump," says Davis. "Many established companies are entering the field and hiring new people, and new companies are starting up as well."

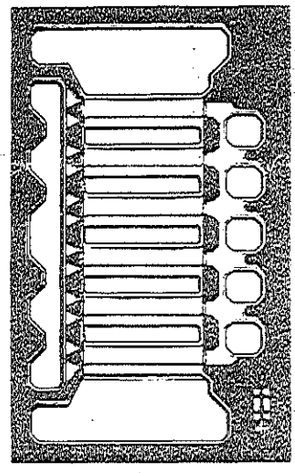
Paradoxically, the raw material at the heart of this newest technological wrinkle was first used commercially nearly 30 years ago in the manufacture of light emitting diodes (LEDs), those ubiquitous red, green or yellow lights and readouts found on digital watches, calculators and electronic instrument panels.

The early '70s saw a boom in the gallium arsenide industry as the compound played an important role in the development of microwave communications.

First gallium arsenide transistors, then integrated circuits, helped revolutionize communications by taking advantage of the compound's ability to handle the higher frequency signals required in satellite transmissions for commercial and defense uses.

"All those big dishes you see at military installations, at high tech companies and in back yards—both receivers and transmitters use gallium arsenide components," says Bruce Hoffman, product marketing manager for Harris Microwave Semiconductor, a Milpitas-based company founded five years ago to develop products using gallium arsenide.

Boosters of the new technology say increases in computation speed made possible by gallium arsenide will usher in a sci-fi future of artificial intelligence and computerized work stations that do everything but scratch an engineer's back.



A one-watt gallium arsenide microwave transformer from Harris Microwave Semiconductor.

Today's fastest computers process data at between five and ten million instructions per second (MIPS). Using gallium arsenide, Texas Instruments and Control Data Corporation are developing a device featuring approximately 10,000 gate arrays (tiny switches on the chip's surface used to direct and store bits of information) and execute instructions at 200 MIPS.

But gallium arsenide received its biggest boost when scientists and strategic theorists determined that the compound's unique properties would permit the creation of "radiation hardened" weapon systems and the ultra-fast supercomputers necessary to control them.

While public attention focuses on the merits and risks of Reagan's controversial Strategic Defense Initiative, the space-based missile defense system known as Star Wars, the less well known Strategic Computing Initiative (SCI) program—initiated in 1984 to develop the computer hardware and software that will make Star Wars possible—proceeds in relative obscurity.

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One of the SCI's primary targets is the development of an autonomous land vehicle able to prowl through the rubble after nuclear explosions, thanks to radiation-hardened components using gallium arsenide. And gallium arsenide chip technology will protect the space-based platforms and satellites that will blast Soviet missiles as they curve through their trajectories.

"Gallium arsenide microprocessors are being developed for very high-speed dedicated uses, such as guided missiles, and for use in outer space where radiation hardness is crucial," explains Davis.

While industry insiders are quick to boast of the compound's technological advantages and its promise of another cycle of technology-driven economic growth, they are less effusive about the dangers of gallium arsenide chip production.

Silicon, the raw material used most commonly in today's chips, is relatively harmless unless inhaled as dust, when it can cause silicosis. Instead, it is the toxic liquids and gases used in the production process that makes manufacturing silicon-based semiconductors dangerous, according to Ted Smith of the Silicon Valley Toxics Coalition.

"The production of gallium arsenide devices is significantly more dangerous than silicon," notes Smith.

Many industry insiders agree with Davis' contention that "In its compound form, gallium arsenide is so safe you could put it in your mouth."

But the gallium arsenide wafers used to fabricate chips and other devices are made by combining gallium—a metal similar to mercury that melts at about room temperature—with arsenic, a powerful poison. Handling arsenic in the production process is inherently more dangerous than working with a relatively benign substance such as silicon, says Smith.

Two gallium arsenide production workers are known to have died from on-the-job exposure. Craig Snuggs, a technician at MIT's Lincoln Laboratory in Lexington, Mass., died in 1982 after inhaling arsine gas. And in June, 1984, John Zemotel, an engineering technician at a Burlington, Mass. firm, died after inhaling toxic gas on the job.

"My concern is not only that gallium arsenide is providing 'Star Wars' technology, but that the processes of chip manufacture are becoming more dangerous rather than less dangerous," says Smith.

"We've been trying for years to make the processes safer. This is a step in the opposite direction."

—Doug Millison