From the Guest Editor's Desk

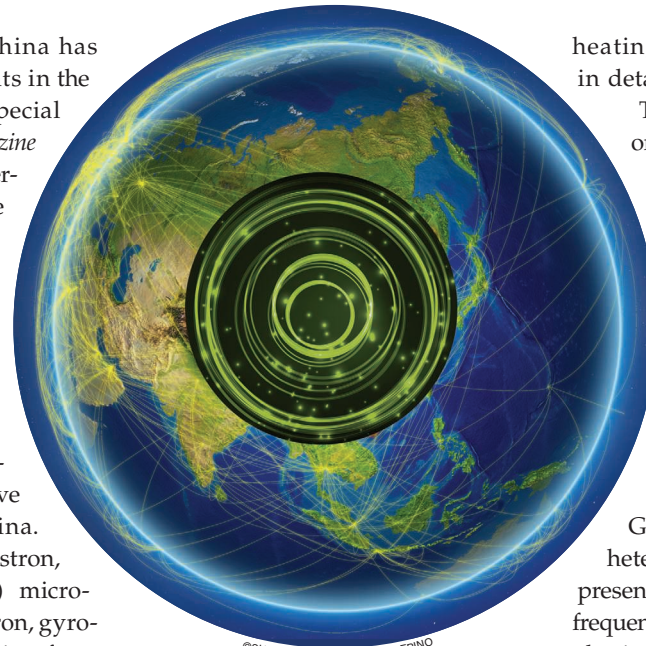
Microwaves in China

■ **Kaixue Ma**

In the past few years, China has made rapid developments in the field of microwaves. This special issue of *IEEE Microwave Magazine* presents three articles on interesting topics related to the state of the art of microwave technology in China. The articles were selected after several rigorous review cycles.

The first article, "A Review of Microwave Vacuum Devices in China" by Luo et al., introduces the research progress on microwave vacuum electronics in China. The authors discuss the klystron, traveling wave tube (TWT) microwave power module, magnetron, gyrotron, and other devices, ranging from the microwave and millimeter-wave to terahertz frequencies.

Significant progress has been achieved in terms of theoretical methods, simulation techniques, device development, and manufacturing technology as well as performance and lifetime for high-power klystrons, space-borne TWTs, gyro-TWTs, and low-temperature/large-current-density cathodes. Benefiting from these developments and advancements, system integration of these devices in such applications as communications, radar, accelerators, and fusion plasma heating, for example, are discussed in detail.



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The second article, "Research on GaN-Based RF Devices" by Hao et al., reviews the challenges and progress of gallium nitride (GaN)-based RF devices and focuses on the manufacturing technologies of high-electron mobility transistors (HEMTs), including heterostructure epitaxial growth and device/circuit processing. The authors first introduce the epitaxial growth of AlGaN/GaN, InAlN/GaN, and AlN/GaN heterojunction materials and then present key processes regarding high-frequency gate structure, low-resistance ohmic contact, and short-channel-effect suppression. A brief introduction to progress in GaN monolithic microwave integrated circuits is given, and the reliability of RF HEMTs is also analyzed.

The final article, "Recent Progress in SISL Circuits and Systems" by Ma et al., introduces a new circuit design and implementation technique, called the *substrate-integrated suspended line* (*SISL*), that was first proposed by Ma and then reviews the recent significant

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progress in SISL circuits and systems. It is demonstrated that SISL preserves all of the benefits, such as low loss and radiation, of traditional waveguide suspended lines, while overcoming the drawbacks of size, cost, and weight. SISL circuits also have advantages of self-packaging and high integration using multilayer fabrication. In this article, the basic SISL concept and structure are reviewed, and published cases of SISL passive and active circuit designs and subsystem implementations are presented.

I would like to sincerely thank *IEEE Microwave Magazine* Editor-in-Chief Prof. Robert Caverly for giving us this excellent opportunity to discuss research advances in microwaves in China. I particularly thank all of the authors and reviewers as well as Assistant Editor Sharri Shaw. Finally, I hope that *IEEE Microwave Magazine* readers enjoy this special issue.

MicroBusiness *(continued from page 12)*

A recent example is the Boeing 737 MAX debacle. A total of 346 people died in two crashes before the plane was grounded and Boeing publicly acknowledged there was a serious problem. It was a human tragedy. It was a business failure. There was an underlying regulatory failure.

Leading up to the introduction of the 737 MAX, there had been decades of ever-decreasing air travel fatality rates. Boeing and Airbus were the two dominant passenger aircraft companies, both with excellent safety records. Boeing had come out with upgraded 737s since the model was introduced in 1967. Almost everything about the company, the industry, and the 737 model was a success story.

Plenty has been written about the 737 MAX failure and what led to it. It's apparent that too many organizations had been too accustomed to success. Boeing was overly confident in its design. Regulators, especially the U.S. Federal Aviation Administration (FAA), were overly confident in Boeing. And everyone else was too confident in the FAA and Boeing.

We want to be successful. There are rewards for being successful. But there is a downside to too much success. It can lead to overconfidence, to hubris. And therein lies the peril.

I vividly recall the Apollo 1 disaster on 27 January 1967. Three U.S. astronauts, Gus Grissom, Ed White, and Roger Chaffee, perished when a fire started inside their capsule. They were on the launch pad, rehearsing for their upcoming flight. It was to have been the first flight of the Apollo spacecraft, which was designed to take men to the moon. In the early 1960s, the United States had embarked on an aggressive program to put astronauts on the moon by the end of the decade. President John F. Kennedy laid out the goal in a speech on 12 September 1962. The U.S. space program had gotten off to a rocky start, with a string of spectacular unmanned flight failures. But by the time of Kennedy's speech, there had been four successful solo manned flights, including one by Gus Grissom.

Once the manned space program was underway within NASA, there was a long string of achievements and successes. The Soviet Union also had an aggressive manned space program, generally achieving milestones just before the United States did. The competition loomed large—it was a space race with more than just prestige on the line. With the Apollo program, the United States was finally poised to take the lead.

After the disaster, there were a number of investigations. How could this have happened when things were going so well? While there were specific causes for the fire (vulnerable wiring and a pure-oxygen atmosphere), underlying issues were really to blame. There was an arrogance in the agency; the schedule was paramount, and concerns were not shared. Documentation of numerous problems with the prime contractor, and with the capsule itself, came to light during the investigation. The NASA administrator, however, had not been informed of them. There was organizational hubris. Numerous problems had come up during the string of successes. There had even been significant failures, some potentially fatal, but NASA was blind to its organizational shortcomings and their impacts.

After the fire, there was a 20-month delay in the program. The capsule was redesigned, and NASA management changed its focus to identify and fix problems and to create a culture of organizational excellence. In the end, the Apollo program was successful, and Neil Armstrong stepped onto the moon on 20 July 1969, meeting John F. Kennedy's goal.

The Apollo program was ultimately a big success. Not everything went to plan, most notably Apollo 13, but there were no more fatalities. The manned space program's goals were met. NASA seemed to have learned how to strive for reliability and excellence, at least until the Challenger space shuttle explosion in 1986. That spawned a new round of investigations and soul searching. So did the Columbia shuttle disaster in 2003.

There is peril in too much success; it inevitably seems to lead to failure. Sustained success is possible, but it can't last forever. The Roman Empire ruled for centuries, but even it eventually failed. So we end with a question: How do we sustain success for as long as possible?