OPINION

How America Lighted the Way for a Japanese Nobel

The award in physics this week overlooked fundamental discoveries made at RCA four decades ago

By
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The Nobel Committee announced Tuesday that it awarded the 2014 prize in physics to Isamu Akasaki, Hiroshi Amano and Shuji Nakamura for inventing the blue light-emitting diode (LED). The long-term significance of this technology is undeniable. By providing a bright source of blue and white light, LEDs have enabled us to transcend Thomas Edison ’s incandescent bulbs or flickering fluorescents. LEDs are more efficient than previous lighting technologies, capable of operating at lower power and for longer periods.

In short, the blue LED offers the prospect of affordable lighting to a world increasingly concerned with sustainability. Yet as much as Messrs. Akasaki, Amano and Nakamura contributed to this lighting revolution, in singling them out the Nobel Committee has framed the blue LED as a purely Japanese invention. Messrs. Akasaki and Amano conducted their LED research at Nagoya University, while Mr. Nakamura—currently a professor at the University of California in Santa Barbara—was employed at Nichia Chemicals in Tokushima.

ENLARGE

U.C. Santa Barbara scientist Shuji Nakamura demonstrates his invention of blue LED light during a news conference after winning the 2014 Nobel Prize for physics on Tuesday.*GETTY IMAGES*

While the Nobel Committee says that the "invention of the blue LED is just twenty years old," its history in fact dates from the late 1960s. And the story of the blue LED begins not in Japan but in New Jersey, at the Princeton laboratories of the Radio Corporation of America.
As America's leading consumer electronics firm, RCA was home to one of the nation's largest semiconductor research groups. Germanium and silicon, the elements used in the first transistors and integrated circuits, received most of the RCA group's attention.

But the company was also interested in so-called compound semiconductors consisting of more than one element, such as gallium arsenide, which RCA's Rubin Braunstein used to build the first infrared LED. (Today, similar devices can be found in your TV's remote control.) Other LEDs, capable of generating red and green light, followed soon after.

In spring 1968, James Tietjen —a chemist in RCA's Material Research Laboratory—initiated a program aimed at creating a blue LED that, when combined with existing red and green LEDs, might enable the construction of a flat-panel color television. Rather than using gallium arsenide, Mr. Tietjen directed another scientist in his group, Herbert Maruska, to look at gallium nitride, a

different compound semiconductor. In theory, gallium nitride would be able to produce a nice blue light, but growing the thin films of material required to construct an LED proved challenging.

By the end of 1968, Mr. Maruska had succeeded in synthesizing gallium-nitride films. However, despite additional assistance from physicist Jacques Pankove and chemist Edward Miller, he was unable to assemble a traditional "PN junction" LED. Such a device required two different kinds of gallium nitride—one with an excess of negative electrons (N-type) and one with fewer electrons that was positively charged (P-type). N-type gallium nitride was easy to produce, but the scientists struggled to find a way to manufacture a P-type material.

Messrs. Maruska, Pankove and Miller set aside their plans for a PN junction in favor of another form of LED that did not require any P-type gallium nitride. Using a new MIS (metal-insulator-semiconductor) architecture, the group successfully built a green gallium-nitride LED in 1971.

The following year Mr. Maruska, who had persuaded RCA to let him continue his LED work while pursuing a Ph.D. at Stanford University, replaced the zinc metal mixed into his diode's insulating layer with magnesium. The result was an LED capable of emitting blue-violet light. Today, this first-ever prototype blue LED is on display at the Sarnoff Collection at the College of New Jersey in Ewing.

Unfortunately, Mr. Maruska's successful demonstration of a blue LED came at a terrible time for RCA. The company was slashing budgets in the wake of their recent withdrawal from the computer market. Funding for research into compound semiconductors dried up, and the gallium-nitride group disbanded. RCA remained interested in flat-panel televisions but no longer viewed LEDs as a means to that end.

Nevertheless, the RCA project continued to shape LED investigations around the world. In 1972 the future Nobel laureate Isamu Akasaki learned about RCA's gallium-nitride research from Jacques Pankove and later visited Princeton to learn more about its LED efforts. Mr. Akasaki and his graduate student Hiroshi Amano picked up where RCA left off, eventually creating a PN junction LED using gallium nitride in 1989. Shuji Nakamura, in turn, built upon that work to

develop improved manufacturing techniques that enabled Nichia Chemicals to announce the mass production of blue LEDs in 1993.

The Japanese scientists who received this year's Nobel Prize in Physics certainly deserve recognition. Together they made the blue LED a practical commercial product. But their work built on material research conducted decades earlier on the other side of the Pacific. Mr. Maruska's prototype may not have matched the performance of its Japanese descendants, but it laid the foundation for the emergence of the LED—a truly international story that has been under way for over 40 years.

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