

Professor Hiroshi Amano was among three scientists who won the 2014 Nobel Prize in physics for inventing blue LEDs, used in smartphones and street lighting. His current research includes working on a new type of transistor that could significantly boost power efficiency in, say, rapid transit systems.
ST PHOTO: DAVE LIM



Nobel Prize winner's bright ideas set to light up the future

Jose Hong

Professor Hiroshi Amano's reticence, his slightly ruffled hair, thoughtful pauses in conversation and occasional subdued laughter make him seem like a typical researcher, more at home in the laboratory than on the global stage.

Yet, since winning the 2014 Nobel Prize in physics with two other researchers for inventing blue light-emitting diodes (LEDs), the Japanese academic has seen his social life mushroom.

Without blue LEDs, there would be no smartphones or the LED lighting systems that cities are increasingly using to illuminate streets.

Prof Amano, who is married with an adult son and daughter, now finds himself a globetrotter, giving talks and interviews abroad.

He was here for one last week, speaking at the International Conference on Materials for Advanced Technologies organised by Nanyang Technological University.

The 56-year-old professor, who is based at Nagoya University's Institute of Materials and Systems for Sustainability, is happy to give talks about what he has worked to achieve over the years.

But it is clear that his focus is on the future. He now manages eight research projects under a consortium founded in 2015.

When asked what he was working on, he listed ideas that could have leapt straight out of a science fiction novel. These include ultraviolet

LEDs that could purify water and lights that could solve myopia – which many children here suffer from.

Another of his ideas – gallium nitride-based (GaN-based) transistors – targets an issue that is close to the hearts of many Singaporeans: how to make trains run better.

Transistors are found everywhere, in mobile phones, radios and trains. Prof Amano said that, conventionally, they are based on silicon and have an energy efficiency of 95 per cent. He wants to raise the level to 99.5 per cent, and to replace the transistors used in Japan's train network, which could have a huge impact on train efficiency.

Asked when the new transistors would appear on the market, he laughed, saying: "It's very difficult to answer, but we are trying to commercialise it by 2020."

He cautioned, however, that replacing the entire network in Japan would take "a long, long time".

Associate Professor Liang Yung Chii, from the engineering faculty at the National University of Singapore, noted that even though an increase of 4.5 percentage points might seem small, the difference is "huge" in terms of systems such as train networks.

MRT trains need at least a few megawatts of power to run. Based on a hypothetical figure of 1MW, Prof Liang said, a 4.5 per cent increase in efficiency would mean that 45,000 watts of power could be saved out of 50,000 wasted watts. Assuming that the transis-

tors now used in MRT trains were 95 per cent efficient, the 50,000 watts would be wasted as heat.

This could raise the temperature of the transistors above 200 deg C, at which point they would be likely to break down, causing train problems, said Prof Liang. So train operators need cooling systems to ensure that the transistors do not overheat, and these systems themselves cost money, take up space and can break down.

Prof Liang said that, apart from saving power and cutting down on heat, GaN-based transistors are several times more resistant to heat than silicon-based ones, and can withstand temperatures of up to 700-800 deg C. Using such transistors would reduce the need for cooling systems, and ensure that most of the power would be used efficiently to drive trains forward.

Existing GaN-based transistors are five to six times more expensive than silicon-based ones, and they can be used only in devices that do not need as much power as trains to run.

Should Prof Amano succeed with his transistors, how society eventually uses them might surprise him. After all, he never expected blue LEDs to end up in street lamps.

"When I was a student (researching blue LEDs), I concentrated on displays only," he recalled.

"I couldn't imagine that many, many people would watch their smartphones on the Japanese subways. It's not a good thing – sometimes, it's dangerous, so be careful," he quipped.

Prof Amano is also looking to the future in other ways. He is often invited to speak to primary, middle and high school students.

"I enjoy it very much – they have new ideas, new questions, new opinions," he said, before leaving to prepare for his lecture here, which had about 150 junior college students in the audience.

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