

Development of a new low-cost gallium nitride (GaN) crystal manufacturing device

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Appearance of THVPE crystal growth furnace. Credit: Taiyo Nippon Sanso Co.

JST announces the successful development of a high-quality bulk GaN growth device based on the THVPE method, a development topic of the Newly extended Technology transfer Program (NexTEP). Development towards commercial applicability was carried out by the Innovation and R&D Division of Taiyo Nippon Sanso from August 2013 to March 2019, based on the research of Professor Akinori Koukitsu of the Tokyo University of Agriculture and Technology. The research team has



developed a GaN crystal manufacturing device that achieves high speed, high quality, and continuous growth.

Gallium nitride (GaN) crystal is a semiconductor widely used as a blue light-emitting diode, but it is also well-suited to use as a power device material in equipment for high-speed switch operation and high-voltage, high-current applications. GaN crystal is far superior to <u>silicon crystal</u>, the current mainstream material.

The majority of GaN crystal substrates used in electronic devices are manufactured using the Hydride Vapor Phase Epitaxy (HVPE) method. It is difficult to produce thick GaN crystals using the HVPE method due to distortions in the crystal, and GaN crystals are grown on a seed crystal heterogeneous <u>substrate</u>, and repeatedly peeled off at a thickness of less than 1mm for use. For this reason, commercially practical manufacturing of GaN crystals has not been possible thus far on the basis of cost and crystal quality, particularly in light of the pre- and postwork required in the process, such as cleaning the furnace.

Taiyo Nippon Sanso has advanced the HVPE method to develop a GaN crystal production system that achieves high-speed, high-quality, continuous growth through the Tri-halide Vapor Phase Epitaxy (THVPE) method utilizing a gallium trichloride-ammonia reaction system. The THVPE method succeeds in forming high-quality crystals at a high-speed growth rate three times faster than current conventional methods, with only one-fifth the current rate of dislocation defects.

The new THVPE method also offers many cost advantages over current techniques, such as not deteriorating quartz glass tube as the reactor, preventing reduction of crystal growth area, and reducing the occurrence of unnecessary polycrystals.

If the THVPE technique can be further developed to achieve production



of thick GaN crystals, it will allow the mass-production of GaN crystal substrates through slicing. The new technique holds strong promise to achieve a breakthrough in the development of low-cost, high-performance GaN devices.

Provided by Japan Science and Technology Agency

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