Single crystal growth of gallium nitride by slow-cooling of its congruent melt under high pressure

Hiroyuki Saitoh, Wataru Utsumi, Hiroshi Kaneko, Koji Kiriyama, and Katsutoshi Aoki
Synchrotron Radiation Research Center, Japan Atomic Energy Research Institute, Mikazuki-cho, Sayo-gun, Hyogo 679-5148, Japan

Although high-quality bulk single crystals of GaN suitable for substrates are desired, the standard method of cooling its stoichiometric melt has been unsuccessful for GaN because it decomposes into Ga and N_2 at high temperatures before its melting points. The decomposition is a common phenomenon for group-III nitride. We have found that applying high pressure completely prevents this decomposition and allows the stoichiometric melting of GaN (Fig.1). At pressures above 6.0GPa, congruent melting of GaN occurred at about 2220°C, and decreasing the temperature allowed the GaN melt to crystallize to the original structure, which was confirmed by *in situ* X-ray diffraction. This result leads to a new method of GaN single crystal growth by slow cooling of its congruent melt under high pressure. Single crystal of GaN was successfully obtained (Fig. 2), which shows narrow X-ray rocking curve whose FWHM is less than 30 arcsec.

Ref: W. Utsumi, H. Saitoh, H. Kaneko, T. Watanuki, K. Aoki and O. Shimomura: Nature Materials 2, 735-738 (2003)

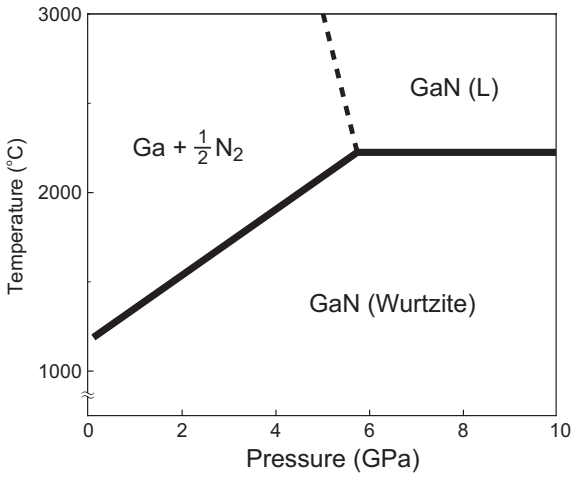

Fig. 1. Phase diagram of GaN under high pressure and temperature.

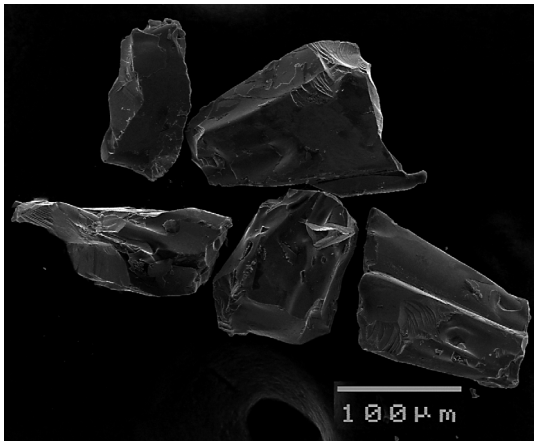

Fig. 2. Scanning electron micrograph of the GaN single crystals.