Growth front of gallium-arsenide crystals determined by synchrotron X-rays

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SPring-8, the largest third-generation (8 GeV) synchrotron radiation facility in the world, provides the most powerful synchrotron radiation currently available.

Japan Atomic Energy Agency (JAEA) scientists have developed a novel technique to determine atomic arrangements and atomic species on semiconductor surfaces during growth using x-rays from SPring-8, a synchrotron radiation facility.

"This technique," says Dr. Masamitu Takahasi of Quantum Beam Science Directorate, "may help improve semiconductor devices used in advanced communication systems, such as mobile phones, optical networking, wireless LAN, and car navigation systems, and may even accelerate the development of new electronic devices."

Dr. Takahasi and his coworkers have integrated a crystal growth

chamber with an x-ray diffractometer at SPring-8 beamline, BL11XU. Then they used this setup to observe the surface of gallium arsenide under growth conditions. Using multi-energy x-rays, they identified both the atomic species and the atomic arrangement in the surface region.

Unlike conventional diffraction techniques, which observe "monochromatic" atomic arrangements, this technique can be compared to "color" imaging of the surface structure. In their most recent work, they experimentally demonstrated that a surface structure called c(4x4), which is observed under certain growth conditions, has dimmers that consist of gallium and arsenic atoms in the topmost layer.

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