EW-MOVPE 2009 Neu-Ulm, Edwin-Scharff-Haus

Short Course 2

June 7, 2009 at 10:15 - 11:45 in Room Studio Stuttgart

Nigel Mason, U.K.:

In-situ optical techniques for MOVPE

Over the last 30 years metalorganic vapor phase epitaxy has changed from being a small-scale research tool to a large-scale industrial activity, particularly in relation to the growth of GaN. Originally, any understanding and analysis of problems occurring during growth was only possible by ex-situ techniques such as photoluminescence, x-ray diffraction or microscopy that were used post-growth. The only in situ tool available was temperature measurement via a thermocouple or pyrometer. Over the last 15 years, the understanding of the chemical and physical processes occurring within the reactor have been transformed by the use of an increasing number of optical tools to measure such parameters as the crystal surface reconstruction, gas phase chemical composition, growth rate, wafer bow and wafer temperature uniformity. Given the complexity of heteroepitaxial growth of GaN on sapphire, it is highly unlikely that without in situ monitoring that this particular technology would have developed so rapidly.

The measurement of the above parameters has been achieved using a variety of white-light based techniques including simple reflectance, ellipsometry, reflectance-difference and reflectance-anisotropy. The white light used [depending on the lamp source] often has a component in the infrared or ultraviolet and thus gives access spectroscopic information from the whole range of III-V and II-VI surfaces. Monochromatic techniques used include reflectance [both normal and at Brewster's angle] as well as laser light scattering. Both types of approach can give very precise information about both the real and imaginary components of the materials refractive index and hence growth rate and crystal film quality.

Wafer temperatures can be measured by a variety of techniques including band-edge determination and pyrometry both the simple passive type and the more complicated emissivity corrected technique.

The lecture will highlight all of the above techniques, critically examine their successes and limitations and attempt to steer the interested student in the direction of appropriate literature where further data is available.

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