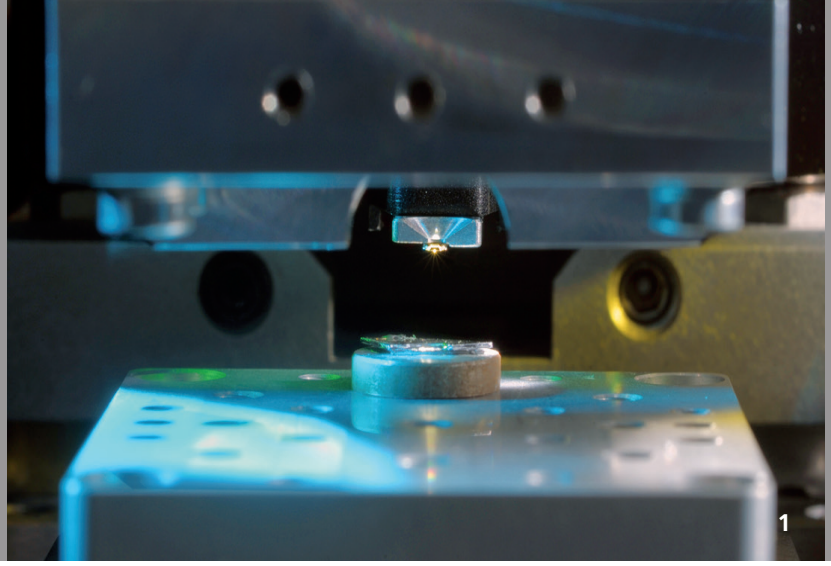

NEAR-FIELD MICROSCOPY OF GALLIUM NITRIDE

Task

Gallium nitride (GaN) is considered to be a material difficult to produce and manage. Blue light emitting diodes are manufactured from it, and the scientists who developed them were awarded the Nobel Prize in Physics in 2014. Indeed, scientists and engineers worldwide are involved in analyzing and improving this material. In close cooperation with the I. Institute of Physics (IA) of the RWTH Aachen University, Fraunhofer ILT has developed an analysis methodology that enables the structural and electronic properties of gallium nitride and gallium nitride composites to be examined optically in the nanometer range, for the first time.

Method

The resolution of conventional optical microscopes reaches its physical limits with objects in the nanometer range. Small structures in the nanometer range, as they, among others, are found in advanced semiconductor devices, can no longer be resolved as isolated objects. On account of this shortcoming, optical analyses are no longer acceptable. The methodology of near-field microscopy overcomes this fundamental limitation and advances optically into the nanometer range. An IR-laser developed at Fraunhofer ILT enables engineers to make a detailed analysis of this material, GaN.

Result

Coupled with the newly developed laser radiation source, the near-field microscope has allowed, for the first time, scientists to characterize several GaN wafers in cross-section with high-resolution. The relaxation of the crystalline structure along the growth direction could be examined in high resolution on an undoped GaN wafer. On a multi-layered wafer for LED production, it was possible to determine the doping of the individual layers as well as to show the smallest differences within the layers.

Applications

In close cooperation with the developers of new semi-conductor devices, employees of Fraunhofer have developed a method which can help, for example, to selectively optimize the process parameters. At a very early stage of development, the physical processes, particularly at the interfaces of the individual layers, can be better understood thanks to the analysis. In the end, these findings may determine subsequent development steps decisively. In the field of high frequency and power electronics as well, the semiconductor material GaN is becoming more and more established due to its physical properties, and analytic processes in the infrared range using near-field microscopy are predestined for the study of these materials.

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1 Near-field microscope.

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