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## NEAR-FIELD MICROSCOPY FOR SEMI-CONDUCTOR ANALYSIS

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### Task

To develop new construction elements in the semi-conductor industry, engineers have to characterize them both structurally and electronically as well as with extreme precision. Conventional optical analysis techniques are principally able to examine these properties; However, their spatial resolution, confined by diffraction, has long been insufficient for modern semi-conductor structures.

### Method

Near-field microscopy (or Scattering Near-Field Optical Microscopy, SNOM) circumvents the classical diffraction limit and allows optical analyses at a spatial resolution of less than 10 nm – independent of the wavelength of the laser light used. Thanks to a broadband tunable laser system, emitting in the middle infrared and developed at Fraunhofer ILT, new spectral fields can be opened up, thereby addressing new issues. For example, tensions in gallium nitride can be examined for the first time, a topic gaining more and more significance for the industry. Equally, doping concentrations or free charges in different materials can be investigated. The unique spectral width of the laser system developed here, in combination with the high spectral beam strength, enables spectroscopic analyses on a nanometer scale within the shortest amount of time.

### Result

For the first time, induced tensions in the crystal structure of gallium nitride could be made visible at spatially high resolution and, additionally, the dominant forces could be quantified spectroscopically. By analogy, the distribution on doped indium arsenite nanowires was displayed and identified. The transition of this measuring technology to further material systems is currently being planned.

### Applications

In addition to applications for characterizing semi-conductor components, near-field microscopy can be used in other fields. Nanocomposite materials can be examined as can common consumer products, e.g. cosmetics with nanoparticles. In order to do this wide spectrum of applications justice, a SNOM application laboratory is being founded at Fraunhofer ILT, which will have access to further microscopy and analysis technologies, such as SEM, SEM-EDX and FTIR.

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1 *Near-field microscope.*