Challenges in the fabrication of devices grown by Molecular Beam Epitaxy

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Scientists around the world demand for high quality and reproducible samples. For the fabrication of tailored devices, molecular beam epitaxy (MBE) has become the method of choice for many universities [1, 2]. In the field of research MBE offers multiple advantages compared to production techniques like chemical vapor deposition, sputtering or liquid phase epitaxy.

One of the main advantages is the flexibility and high adaptability to address the different needs of growth for various devices: microcavities for cavity quantum electronics and light-matter coupling [3], organic and inorganic nanostructures for novel optical devices [4] as well as topological insulators for fundamental research [5].

We like to focus on typical questions and challenges which arise during the growth of high quality samples with molecular beam epitaxy. The questions on the one hand are related to the system and affect the desired homogeneity profile (Figure 1) and wafer temperature uniformity. Challenges on the other hand are influenced by the increasing requirements for high-precision and reproducible samples. In order to reach these requirements we need to push the physical limit set by the MBE-system. Background-doping, shutter transients and defect density are typical concerns which need to be addressed.

References

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Figures

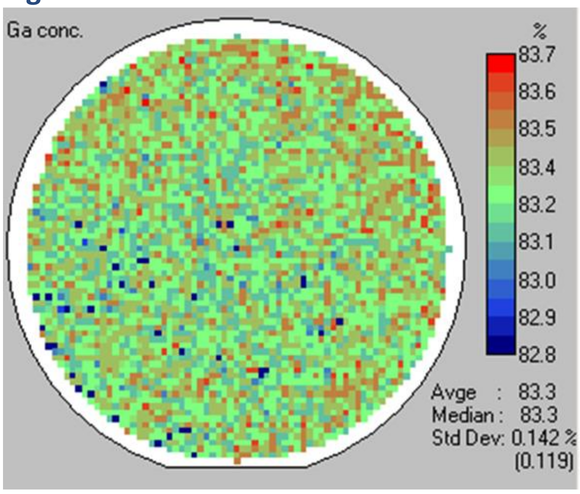

Figure 1. Room Temperature Photoluminescence Map of a thick InGaAs layer on a 3” wafer proving negligible compositional variation of Indium and Gallium across wafer

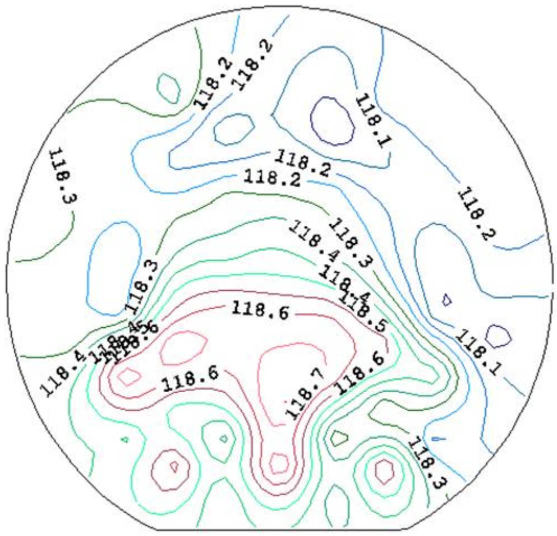

Figure 2. Silicon Doping Uniformity map on a 3” wafer generated from 55 test points. Since Si doping is fairly insensitive to growth conditions, the test is good representation of flux uniformity which shows a standard variation of 0.19%.