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Transient Simulation of InGaN Growth

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The Indium concentration profile is a very important input for electrical potential as well as for transport calculations of the InGaN QW structures. Several studies aim to clarify the effect of QW shapes on the emission wavelength and intensity. The shape of the QWs is determined by many factors. However, most of them stem from growth conditions, as in the case of InGaN only minor changes occur to the QW shape through bulk diffusion due to the very low InN/GaN binary diffusivity. Therefore, a comprehensive simulation of growth conditions can generate extremely valuable input for understanding the properties of MQW structures.

Here, we present the full Indium concentration profile of MQW structures as result of growth condition modeling. We developed a simulation for a commercial production scale reactor that successfully bridges the gap of time scales from 10^{-5} seconds as minimum time step due to flow constraints to 10^{5} seconds of MQW growth time. The model has to be sufficiently accurate to capture the most important transport phenomena, but it has to be as coarse as possible to meet the simulation time constraint.

From catalytic combustion simulations that usually require detailed reaction mechanisms it is known that reaction rate calculations take approximately 90% of simulation time. Therefore, a reaction mechanism that can be used for transient simulations has to be relatively simple but accurate enough to yield useful results. The most qualified model for such a job is a semi-empirical model, that incorporates a number of elementary reactions as well as global reactions whose constants can be fitted to experimental results. Such a model is currently developed in the EU funded project NEWLED by STR-Group and validated at OSRAM OS.

We present the first validation results from two dimensional reactor modeling and its comparison with the composition profiles (fig. 1) obtained by a dark-field electron holography at CEMES-CNRS. A good correlation was achieved between the simulation and the experimental data.

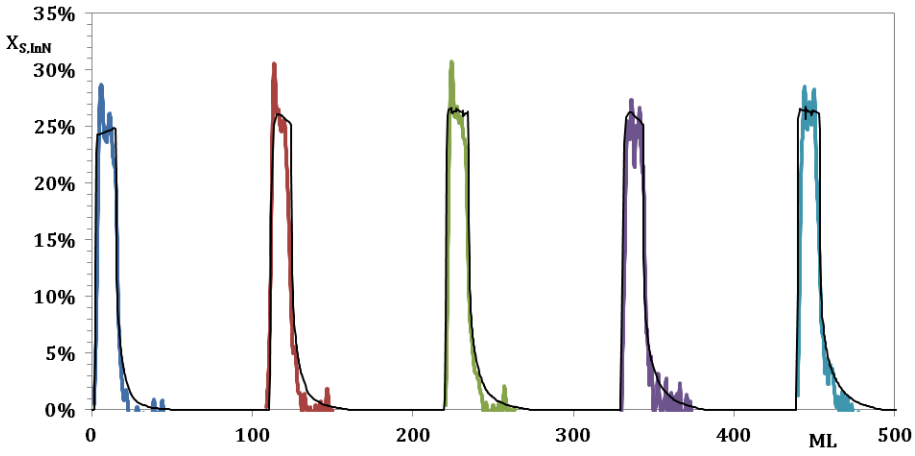

FIG. 1: InN profile (black line for simulation, color lines for experiment)