

Review Report

on the manuscript entitled “**Impact of the dislocation density on the transient photoluminescence intensity in GaN**”

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In this paper the time-resolved photoluminescence in a layer of GaN semiconductor with an embedded array of threading dislocations is studied. An instantaneous spatially uniform source of excitons is considered. The transport and recombination of excitons is governed by a 3D transient drift-diffusion-recombination equation with mixed Dirichlet and Robin boundary conditions on the plane surface and the cylindrical boundaries of the dislocations.

The authors suggest and develop a stochastic simulation algorithm, which solves this problem by tracking exciton trajectories. The drift of the excitons is affected by the piezoelectric fields around the dislocations. The parameters of the piezoelectric field, the exciton's diffusion length and its mean life time are taken from the experimental study published recently in Phys. Rev. Applied, v.17 (2023).

The main finding in the paper under review concerns the relation between the photoluminescence intensity and the dislocation density. It is shown that from a transient photoluminescence curve it is possible to extract the dislocation density with high resolution. The used Monte Carlo algorithm is clearly described in the paper. The obtained numerical experiments are well described and presented. The results are quite impressive.

The main Monte Carlo method used by the authors is the extension of the Random Walk on spheres to a general case of transient drift-diffusion-recombination equations developed in the paper of the first author K.K. Sabelfeld: Random Walk on spheres algorithm for solving transient drift-diffusion-reaction problems, MCMA, 2017, vol.23, issue 3, 189-212.

The manuscript is clear, relevant for the field and is presented in a well-structured manner. The cited references are relevant. The paper is rich mathematically, the authors have derived new spherical mean value integral relations and proved different reciprocity relations between direct and adjoint equations, and rigorously mathematically derived probabilistic methods for their solution.

The figures and pictured are appropriate and clear. They are easy to interpret and understand. The statements and conclusions drawn are coherent and supported by the listed citations.

The study performed by the authors is relevant, interesting and, in general, the effort made is really appreciated.

Final recommendation: The paper is original, well written and I recommend to publish it.



Signature:

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