THE IMPACTS OF SILICA ON COLOR UNIFORM OF LIGHT EMITTING DIODES VALIDATED BY COMPUTER SIMULATION

Nguyen Van Dung[1], *Phan Xuan Le*[2], *Sang Dang Ho* [3], *Hsiao-Yi Lee* [4,*]

[1]Faculty of Engineering, Dong Nai Technology University, Dong Nai Province, Vietnam.
[2]Faculty of Electrical Engineering Technology, Industrial University of Ho Chi Minh City, Ho Chi Minh City, Vietnam.
[3]Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam.
[4]Department of Electrical Engineering, National Kaohsiung University of Science and Technology, Kaohsiung, Taiwan

*Corresponding Author: Hsiao-Yi Lee (Email: leehy@nkust.edu.tw)
(Received: 14-May-2025; accepted: 18-September-2025; published: 30-September-2025)
http://dx.doi.org/10.55579/jaec.202593.495

Abstract. *Certain methods involving inclusive-optic temporal-solved were employed for assessing the dynamism for individual conveyors within InGaN quantum formations subject to significant exciting condition. The conveyor duration as well as dispersion coefficient all display their considerable reliance upon the exciting power: under surging conveyor denseness, conveyor duration lessens while dispersiveness surges. Said mechanism have a greater presence for sampling units featuring greater In amount. Our empirical data is assessed under the setting involving dispersion-augmented reconsolidation caused by potent conveyor's distinctive location within InGaN. Judging said setting, the pace for nonradioactive reconsolidation surges as the exciting process surges, being the cause for the sink activity for InGaN. The ABC evaluating expression for fitting illumination generated momentary latticework (IGML) motion was employed, denoting that the straightforward conveyor duration diminishes as the exciting process lessens, known as surplus conveyor denseness. Effect from Auger reconsolidation did not manifest, reaching the peak conveyor denseness which would be restricted under the emergence for highly rapid recreated reconsolidation activity. For the task of validating our assessment, the study herein concerns spectrum-solved distinctive transference information displaying reconsolidation paces for conveyors within native as well as expanded statuses.*

Keywords: *Color rendering index; Dual-layer phosphor; Luminous efficacy; Mie-scattering theory; Triple-layer phosphor.*

1. Introduction

With significant interest throughout the recent times, conclusion remains ambiguous when it comes to the precise microscale mechanism for inner quantum proficiency (IQP) penalty, called sink, for InGaN LED apparatuses [1–3]. While multiple feasible concepts were projected, answer has not been found for the primary cause of nonradioactive penalties within potent apparatuses [4]. Much research was done to examine electrical-conducted LED apparatuses that would become intricate multi-sheet formations under electric exposure. Subsequently, certain projected sink concepts, including undesirable cavity administration as well as the linked conveyor leaking or joint heat, may result from the distinctive attributes for LED formations [5]. Regardless, according to available studies, the IQP penalty would manifest for bulk GaN matter, denoting that certain inner nonradioactive attributes may manifest under significant administration. Auger reconsolidation would be widely considered a penalty cause with the highest feasibility, notably with hypothetical assessments asserting that metallic compounds as well as phonon-aided Auger activities cause fairly huge results for Auger coefficient within InGaN, though under one specific resonation power. Regardless, certain works project different feasible causes, including denseness triggered fault reconsolidation, saturation for radioactive reconsolidation pace as well as conveyor over-flux within quantum well units (QWU) [6–8].

The research herein concerns the issue for conveyor reconsolidation trails within InGaN QWUs via employing multiple temporal-solved methods, including IGML, temporal-solved photoluminescence (TSP) as well as distinctive transference. Said excitation-examination methods would be desirable when it comes to assessing the conveyor reconsolidation pace for the ability to enable straightforward tracking for immediate conveyor denseness under no intrusion from electric exposure activity [9]. Said methods enabled the examination for reconsolidation pace as well as dispersiveness within multiple InGaN QWU formations associated with factors including individual conveyor denseness, heat level, In presence as well as blockade breadth [10, 11]. Based on our empirical as well as hypothetical information, the conveyor distinctive location as well as intrinsic electric zones would be the primary causes resulting in the excitation reliance for conveyor reconsolidation pace as well as dispersiveness [12–14].

2. Experimental

The study herein concerns two groups of sampling units. The fabrication of said units was based on an earlier study [15]. The initial group includes six units developed upon c-side sapphire via metallic-organic fume accumulation (MOFA). Above one GaN cushion, blockades as well as ten InGaN/GaN (I/G) QWUs were developed. The ratio for TMIn/TMGa underwent variance throughout the development for QWUs featuring disparate In presence. Sheet breadths were identified via Xray diffraction with well breadth displaying variance for each unit whereas blockade breadths were static. The referential no-In unit was developed under identical states. The approximated In presence within QWUs via photoluminescence (PL) exhibited variance within a large span. The next group for units comprising dual LED formations featuring six-sequence QWUs featuring fixed well breadth as well as altering blockade breadths that signify linked as well as non-linked multi-quantum well units (MQWUs). Our LED formations were developed using n-category GaN frames above sapphire then merged with underlaying Si-integrated InGaN sheets with the goal of augmenting the performance for overdeveloped functioning zones, stair-form electronic administrators (dual InGaN sheets featuring progressively surging In presence) with the goal of proficiently thermalizing heated conveyors preceding administration unto the functioning zone as well as p-category GaN enveloping sheets [16, 17]. Different from the standard pump-examination settings that excite units via Gaussian-resembling space outline, IGML featuring exciting processes utilizes intrusion zone for dual consistent rays. Said method enables tracking for time diffraction latticework that is examinable via diffraction for one adjourned examining ray. It offers multiple benefits, notably the possibility for assessing conveyor duration as well as dispersiveness concurrently. On the other hand, the IGML indicator, being the diffraction proficiency, would be proportionally associated with the zone for individual conveyor denseness, implemented across the depth subject to excitation, meaning that this is one proficient approach for assessing immediate conveyor denseness. The IGML setting featured one YAG:Nd3+ reiteration pace laser discharging bursts. In terms of exciting process, the periodicity-threefold ray was utilized generating a momentary latticework for a unit utilizing one holograph ray cleaver (HRC). The absorptivity coefficient yielded a tiny exciting depth as well as significant conveyor denseness [18-20]. The empirical setting in the case of temporal-solved distinctive transference featured one Ti:sapphire femtosecond laser discharging bursts. The laser's yielded power was segregated to form two equivalent portions [18]. A portion was utilized for pumping the optic parameter intensifier discharging bursts under continually adjustable wavelength levels. The pump underwent assimilation solely into the QWUs, circumventing conveyor optic-inducement within the blockades, cushion as well as enveloping sheets. The secondary ray was adjourned then utilized for creating white illumination within one CaF2 window. The distinctive transference method enabled the tracking of the development in status settlement within InGaN QWUs featuring significant time as well as spectrum resolution. As InGaN is utilized in this case, the emitted wavelength can range between UV and green in the simulation. In the case of TPS assessment, one basic setting for temporal-solved PL spectroscopic assessment was utilized via dual-periodicity bursts generated by one Ti-sapphire laser with the goal of selectively exciting QWUs accompanied by one spectrometric apparatus as well as one tracing camera [19–21].

3. Results and Discussion

For the task of examining the transference as well as non-straightforward reconsolidation for surplus conveyors, the IGML motion was tracked for every unit under multiple exciting power variances over a span. The exciting span was restricted through the responsiveness for the formation under the small power plane as well as through the manifestation for roused reconsolidation within the strong power plane [22]. The roused reconsolidation functions in the form of a highly rapid reconsolidation pathway abolish every individual conveyor exceeding one specific limit [23]. Moreover, the IGML motion was assessed under multiple sequences for momentary latticework, enabling the assessment for proficient conveyor duration as well as dispersiveness. Notably, the empirically acquired proficient duration signifies a merge between multiple reconsolidation activities, not resembling the straightforward conveyor duration primarily resulting from the nonradioactive conveyor reconsolidation via faults [24]. The IGML degradation within the referential GaN sheet proved to be singularly exponential. Conversely, the empirically assessed IGML motion within InGaN would be highly reliant upon exciting processes. Regardless, under the smallest exciting process, the degradation within InGaN metallic compound would be almost exponential while the sluggish degradation rears yield the proficient duration outcome.

The IGML motion within every InGaN sheets would turn progressively non-exponential under surging exciting process while the preliminary element degrading at a higher rate under greater conveyor denseness. Said mechanism have a greater presence within QWUs featuring higher In amount and would be one common attribute for non-straightforward reconsolidation activities that would be typically drafted via consistency expression regarding space as well as time allocation for surplus conveyors, being the ABC expression [25–27]:

$$\frac{\partial N(x,z,t)}{\partial t} = D\nabla^2 N(x,z,t) - \frac{N(x,z,t)}{\tau_R} - BN^2(x,z,t) - CN^3(x,z,t) + G(x,z,t) \tag{1}$$

$G(x,z,t)$ signifies the conveyor inducement pace. D signifies the ambi-pole dispersion coefficient. τ_R signifies the linearity. B and C signify the bi-granular and Auger diffraction coefficients. It is possible to utilize expression (1) for assessing the refractivity indicator attunement $\Delta(z,t) = n_{eh}\Delta N(z,t)$ (n_{eh} signifying the indicator variation caused via a conveyor) as well as diffraction proficiency $\eta(t)$, empirically assessed via the IGML method:

$$\eta(t) = \left|\frac{2\pi}{\lambda_1}\int_0^d \Delta n(z,t)dz\right|^2 \tag{2}$$

Figure ? shows the scattering coefficients at various SiO2 and wavelength levels. It is well known that the scattering coefficient may evaluate optical performance in LED devices by boosting dispersion activities, which improves chroma and illumination allocation precision. In any event, significant concentrations of that material may impair brightness because light is limited or directed inefficiently. This coefficient rises with larger SiO_2 particle sizes and is proportional to wavelength level, which causes dispersion for the light produced by the blue chip to propagate and then more convert into rays at longer wavelengths. Then, when the blue-ray dispersion in the front discharge surge with the blue-ray repeating absorptivity and rear-dispersion decreased, the luminescence will be increased [28]. The particle size can influence CCT levels, as shown by Figure 1. Under a particle size of 5 wt.%, the CCT shows the most noticeable fluctuations. The CCT is at its lowest

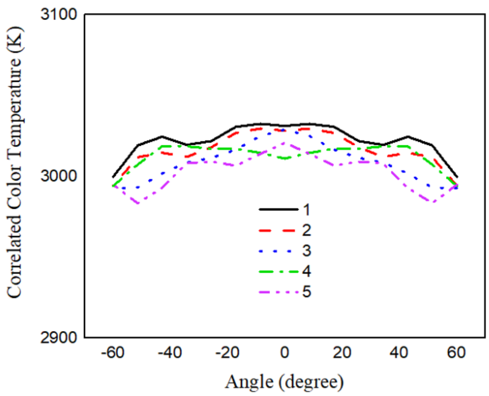

Fig. 1: CCT alteration based on particle size.

The hue aberration shows various fluctuations under various particle sizes, as demonstrated by Figure 2. Notably, the hue aberration shows a very significant increase when the particle size reaches 3 wt.%. In contrast, it shows the lowest values under 5 wt.%. For the lumen in LED shown in Figure 3, it sees noticeable fluctuations between particle sizes of 1 and 5 μm. At the particle size of 2 μm, the lumen shows its peak value, in contrast to the lowest value at 4 μm. The observed changes may be the consequence of the difference in color allocation and the lower intensity of the blue discharge due to increased rear-dispersion and repeated absorptivity. It should be noted that as particle size increases, the phosphor sheet typically has a wider width, which lowers the energy of the whole spectrum. As a result, the lighting transmutation between blue and yellow or red-orange will be more pronounced. This indicates that the transmuted beam may participate in rear-reflection under extremely large particle sizes, which would reduce the luminous intensity and produce a higher CCT level [29].

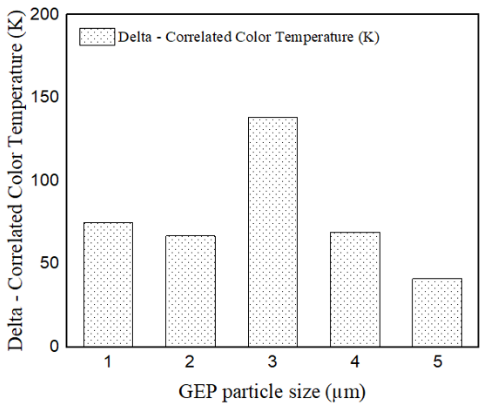

Fig. 2: Variation in hue aberration under SiO_2 particle size.

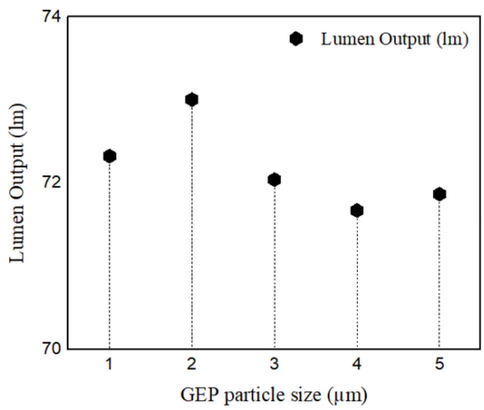

Fig. 3: LED lumen generated based on SiO_2 particle size.

4. Conclusion

The study herein concerns the conveyor dynamism within InGaN MQWU LED formations featuring multiple In amounts via temporal-solved IGML, PL as well as distinctive transference methods. With our assessment that exhibits empirical as well as numeric outcomes, it is possible to interpret the reliance of conveyor duration as well as dispersiveness upon conveyor denseness via an expression involving denseness triggered fault diffraction. Specifically, judging the expression, the pace for diffraction faults may surge as the exciting process surges within InGaN under the highly potent conveyor's distinctive location. Said mechanism may become one feasible approach for the sink issue within InGaN rather than the Auger activity. The Auger influence was negligible upon conveyor dynamism reaching the apex conveyor denseness restricted under the manifestation for highly rapid recreated reconsolidation activity. Moreover, the practicality for ABC examining expression would turn restricted under distinctive location influences since coefficients A as well as B would be associated with conveyor denseness. The spectrum-solved distinctive transference information validates our outcomes via assessing disparate alleviation paces for conveyors within native as well as expanded statuses for MQWU. Assessment for distinctive transference as well as TPS elements within LED formations exhibited a significant reliance of conveyor dynamism upon blockade breadths.

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About Authors

Nguyen Van DUNG received a Master's degree in mechanical engineering from the University of Technical Education, Ho Chi Minh City, Vietnam, and is currently working as a lecturer at the Faculty of Engineering, Dong Nai Technology University, Bien Hoa City, Vietnam. His research interests include system optimization techniques, simulation and modeling, machine design, mold design. In this paper, he contributed: software, validation, investigation, resources, data curation, review, visualization. He can be contacted at email: .

Phan Xuan LE received the Ph.D degree in Mechanical and Electrical Engineering from Kunming University of Science and Technology, Kunming city, Yunnan province, China. Currently, He is a lecturer at the Faculty of Electrical Engineering Technology, Industrial University of Ho Chi Minh City, Ho Chi Minh City, Vietnam. His research interests are optoelectronics (LED), power transmission and automation equipment. He can be contacted at email: nguyenvandung@dntu.edu.vn.

Sang Dang HO was born in Ho Chi Minh City, Vietnam in 1973. He received the M.Ss. degree in Electrical Engineering from Ho Chi Minh University of Technology, Ho Chi Minh City, Vietnam in 2008, and received the Ph.D. degree in Electrical Engineering from VSB-Technical University of Ostrava, Czech Republic, in 2020. Presently, he is working as a lecturer at the Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam. His research interests involve the optimization of the power system and applications of soft computing in control of electric machine drives and optics science.

Hsiao-Yi LEE was born in Hsinchu city, Taiwan. He has been working at the Department of Electrical Engineering, National Kaohsiung University of Science and Technology, Kaohsiung, Taiwan. His research interest is optics science.

