APSYS Simulation of hot Auger electron leakage in InGaN MQW LED
Introduction

Recent direct measurement of electron leakage triggered by QW Auger recombination. PRL 110, 177406 (2013)
APSYS models related to efficiency droop

- Polarization charge induced well/barrier potential distortion.
- Cold carrier leakage over barriers and EBL, using default drift-diffusion and thermionic emission models.
- Hot-carrier induced non-local transport. Quantum well escape or capture, and barrier-to-barrier fly-over. Sequential or collective non-local hot carrier transport.
- Collective non-local hot Auger carrier leakage from above well to p-contact via thermionic emission (Auger-thermionic model).
- Collective non-local direct escape of confined carriers from well to p-contact with Auger recombination rate (Auger-direct model).
- Collective non-local emission of above-barrier hot carriers to p-contact with Auger rate (Auger-indirect model).
Demo example: InGaN/GaN MQW LED with EBL
Conduction band for different EBL band offsets

Comparison of conduction band showing polarization charge induced potential distortion for different EBL band offsets
Hot carrier non-local transport

Band diagram indicating collective hot carrier non-local transport mesh connections through the MQW system. Superimposed on default drift-diffusion/thermionic solution.
Comparison of LED emission power

![Graph comparing LED emission power](image)

- Ref (EBL offset=0.7)
- EBL offset=0.5
- Auger-thermionic
- Auger-direct
- Auger-indirect

Y-axis: Broad Area LED Total Power (Watt/cm^2)
X-axis: Current (A/cm^2)
Comparison of LED IQE
Many effects can cause LED droop.

APSYS may simulate and study various possible droop causes in LED, including hot Auger carrier leakage.

Non-local quantum well transport model is an effective means of treating hot carriers within the drift-diffusion based simulator.

Based on IQE tendency, both Auger-thermionic and Auger-indirect models can fit measurement.