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EpiEL Probes: Type I vs. Type II

This application note presents a brief comparison between **Type I** and **Type II** EpiEL probes.

Currently MaxMile EpiEL mapping systems use two types of EpiEL probes which are called **Type I** and **Type II** correspondingly. Both types of probes can be used without any change of hardware configuration of EpiEL probe station. Though the electroluminescence characterization results provided by both types of probes can be practically correlated with that of real devices through equivalent driving current density, the different types of EpiEL probes were developed to meet different application requirements:

1. Type I EpiEL probe

Type I EpiEL probe can be used to reveal the electroluminescence characteristics of wide driving current density. Without causing catastrophic damage to the material, it can reach the equivalent driving current density far beyond the rated current density of the corresponding device. This type of probe has less accuracy in measuring the value of driving voltage, but it has its unique advantage to investigate the electroluminescence characteristics over large driving current density, such as emissive efficiency, peak wavelength or FWHM change as driving current changes. These informations can be used to optimize the rated working condition of fabricated device as well as device structure in some laser diode development.

2. Type II EpiEL Probe

Compared to **Type I EpiEL probe**, **Type II EpiEL probe** uses a relatively low current density. It can be customized to the contact size close to real device. This type of probe can be used to form different size of devices in the epiwafers which could closely simulate the device working condition for each application. **Type II EpiEL probe** has excellent accuracy in measuring the value of turn-on & driving voltages and wafer-to-wafer variation.

Figure 1 and 2 show typical peak wavelength and FWHM characteristics measured with **Type I** and **Type II** EpiEL probes respectively which were acquired from the same location of a blue GaN LED epiwafer. Both figures indicated that the peak wavelength decreases, while FWHM increases, as driving current increases. However, from rough estimation of the value of peak wavelength and FWHM, figure 2 only reveals the small potion of peak wavelength and FWHM characteristics of figure 1. In other word, Figure 1 covers much wider equivalent driving current density than Figure 2 does. Of course, at low current density, Figure 2 reveals more detailed information than Figure 1 does. Figure 2 also indicates that, at the very beginning of emitting light, the peak wavelength increases while FWHM decreases as driving current increases.

Though **Type I** and **Type II** EpiEL probes has different performance in EpiEL measurement, the electroluminescence characterization results provided by both types of probes, as well as real device fab, are practically convertible to each other through equivalent driving current density.

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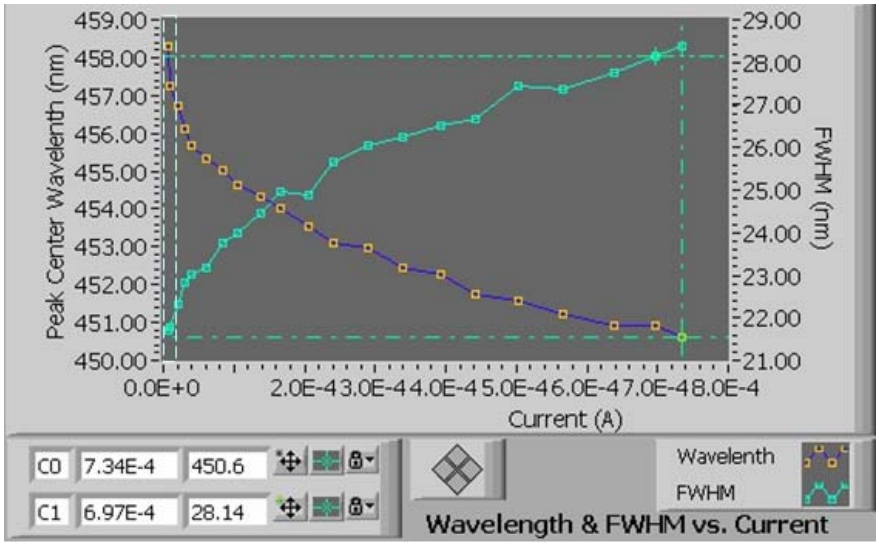

Figure 1, Peak wavelength and FWHM characteristics, measured with Type I EpiEL probe

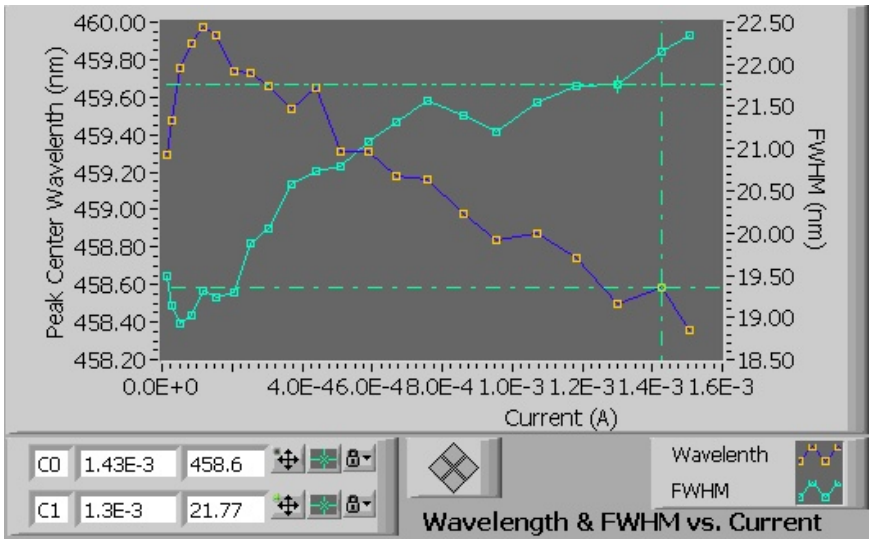

Figure 2, Peak wavelength and FWHM characteristics, measured with Type II EpiEL probe from the same spot of the sample used in Figure 1; this measurement reveals only small potion of peak wavelength and FWHM characteristics of figure 1 (marked with dashed lines)