

Report Title

Imaging Micro-Photoluminescence and Confocal Photoluminescence Microscopy for Determination of Interfacial Defect Densities in Semiconductors

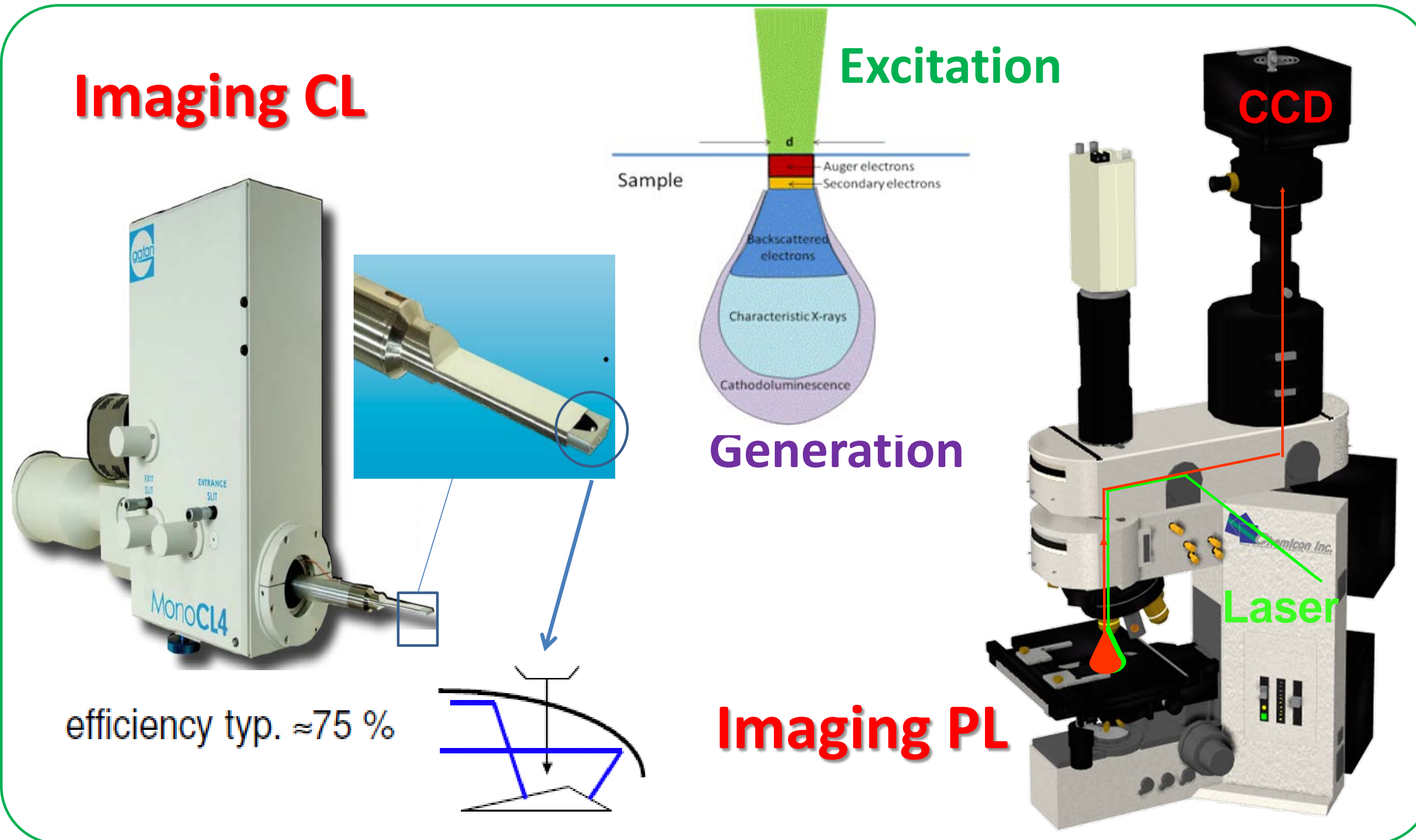
ABSTRACT

Low dislocation density is important for optoelectronic devices requiring long minority carrier lifetimes. The classic method of measuring dislocation density is to subject a material to a chemical etchant that produces a pit at the intersection of a dislocation with the surface. The measurement of dislocation density then is a measurement of etch pit density. For conventional materials recipes for generating etch pits are commonplace. For other materials, dislocation etching is not well-established with different chemistries required for different crystal orientations. Cathodoluminescence (CL) has also been shown to be an effective tool for measuring dislocation density. Dislocations intersecting the surface strongly reduce the intensity of the intrinsic CL producing a dark spot associated with a threading dislocation. This technique also measures other non-radiative features such as precipitates or inclusions. We evaluate two types of photoluminescence (PL) mapping to measure non-radiative defects and correlate the measurements with CL. The primary impetus is to develop an optical technique that can be used in a more production-friendly environment without degrading sample surfaces while producing accurate dislocation densities. This study illustrates the utility of each technique while contrasting the strengths and weaknesses.

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Imaging CL

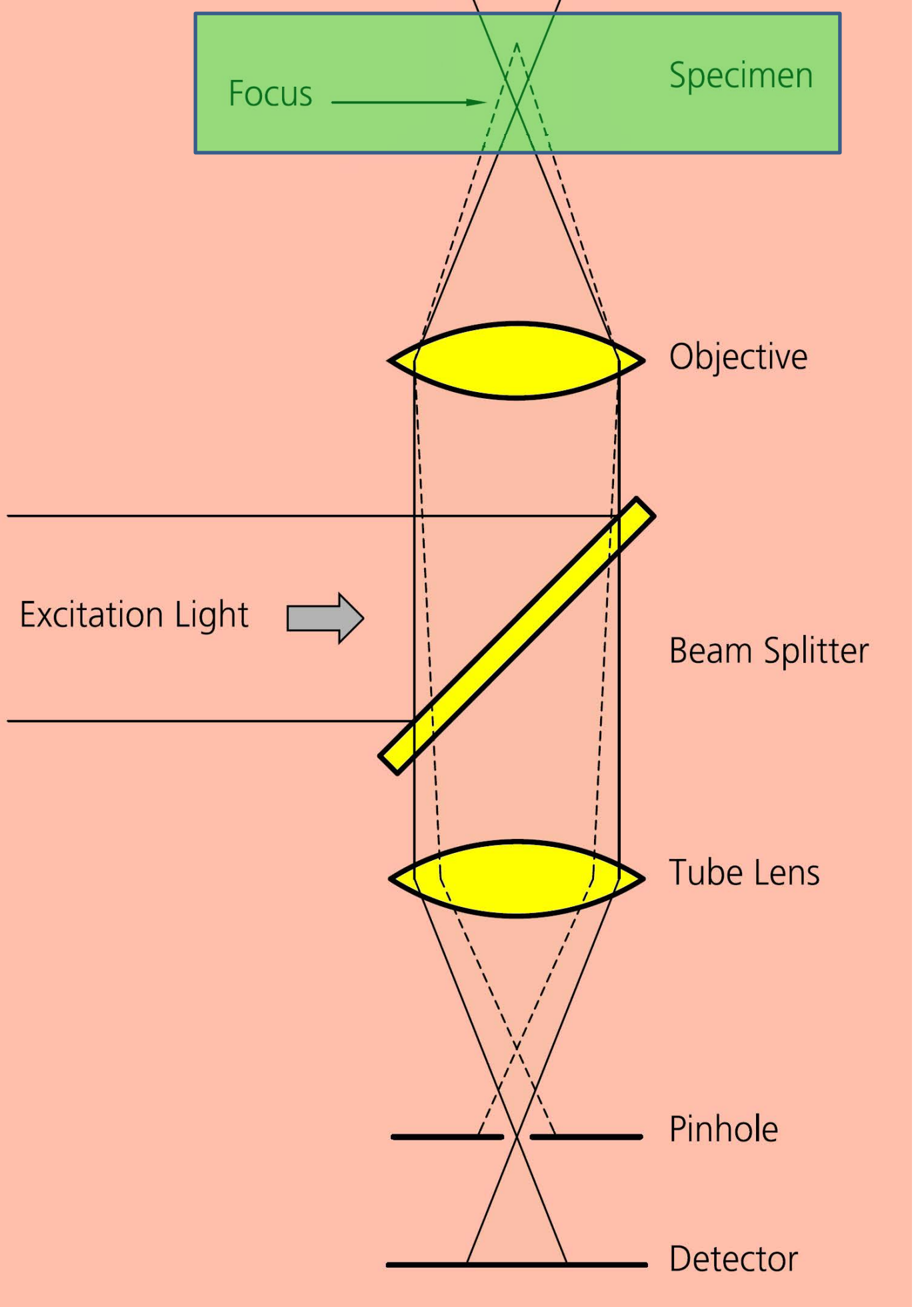
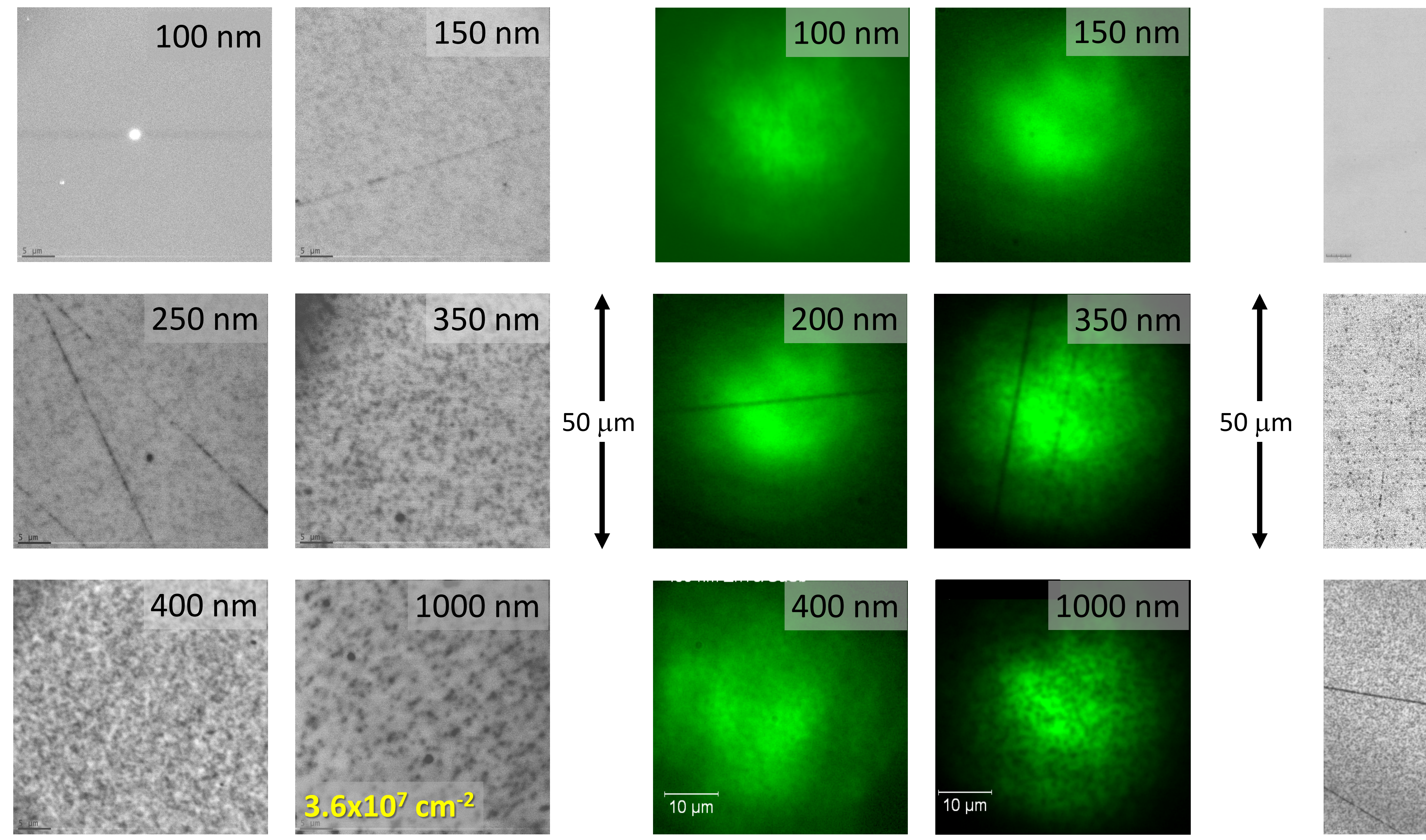


50 – 2100 nm ZnTe
ZnTe nucleation
GaSb(211)B

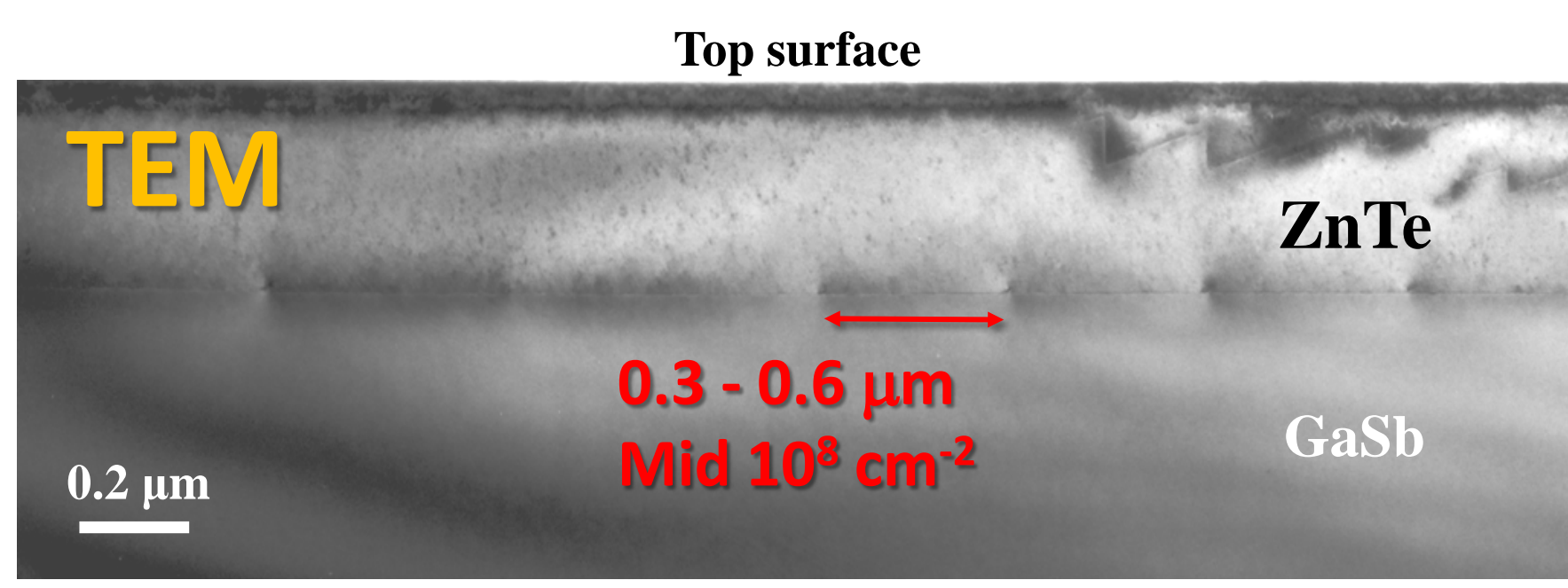
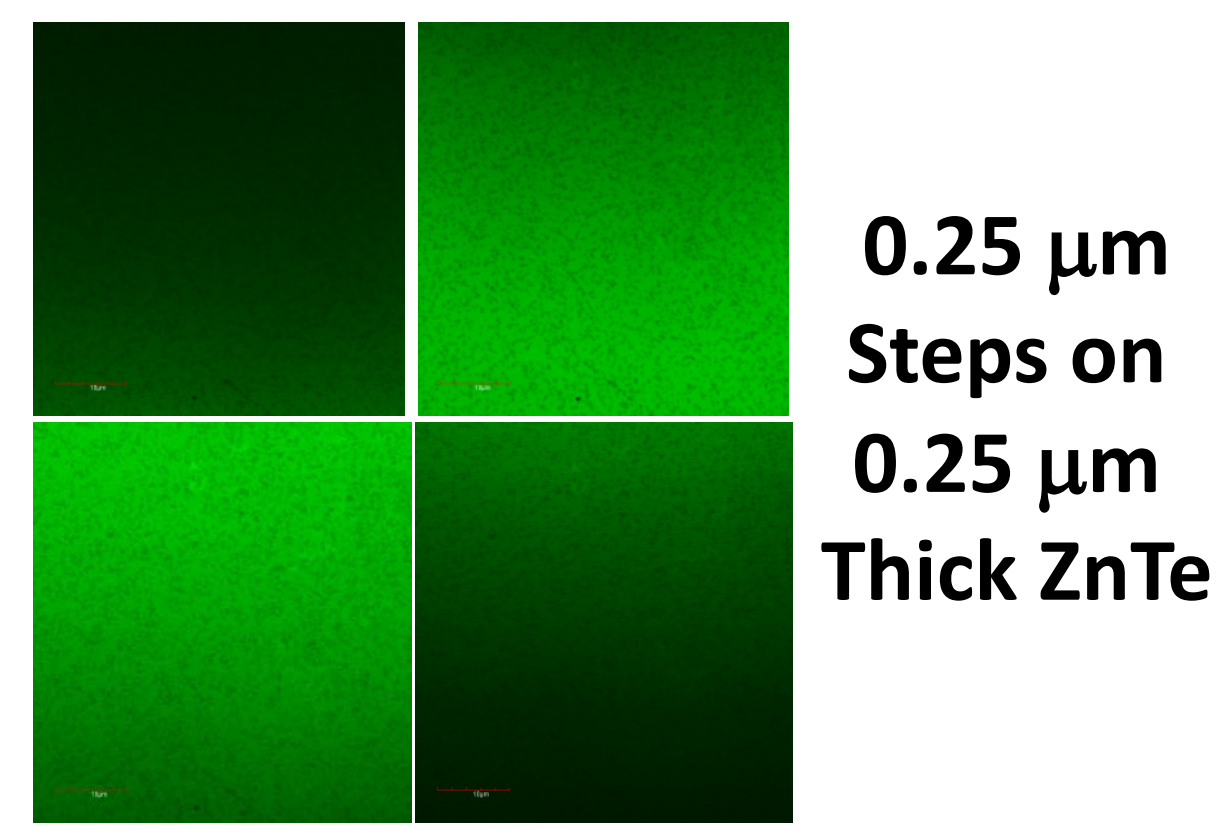
Imaging CL

Imaging PL

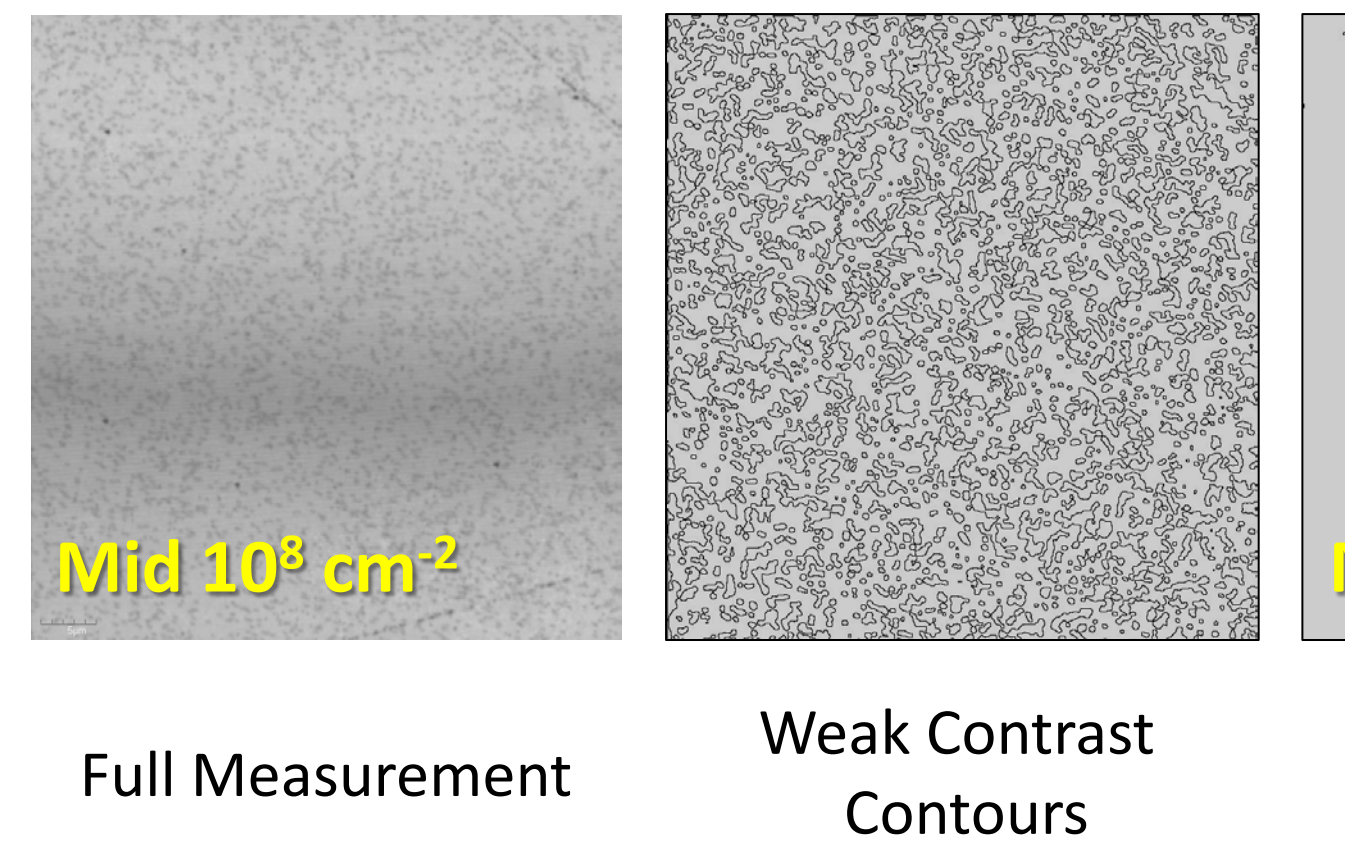
Confocal PL



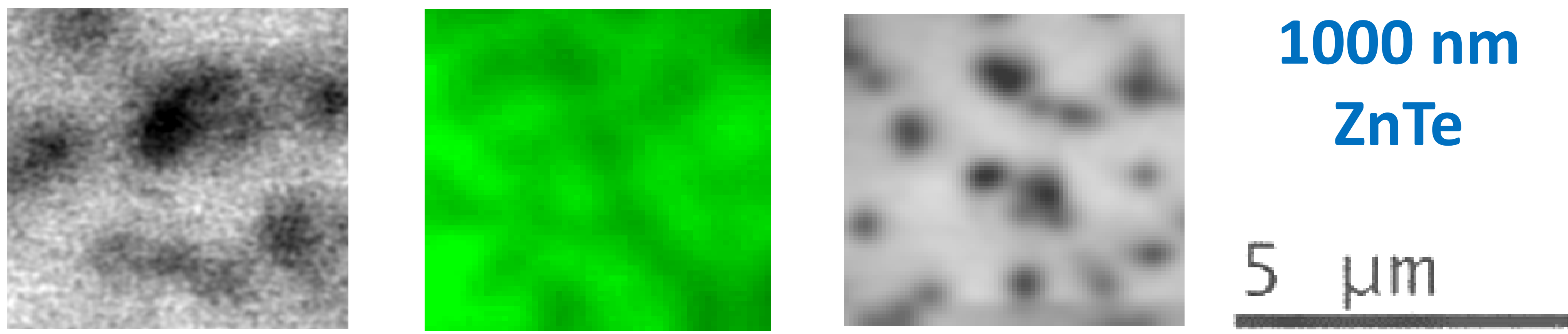
Laser Confocal Microscopy (Confocal PL)



250 nm ZnTe/GaSb
TEM ⇒ Low threading dislocation density
Confocal PL, CL ⇒ High density of dark spots



Confocal PL provides highest contrast



Principle of confocal imaging