Photoluminescence for quantitative analysis of nonradiative recombination in semiconductors

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Photoluminescence (PL) is perhaps the most ubiquitous optical spectroscopy technique for semiconductor material characterization, but typically used as a qualitative tool for assessing the material quality. To determine the characteristics of nonradiative recombination centers, deep level transient spectroscopy (DLTS) is often used. We have demonstrated an all-optical approach, combing PL and Raman spectroscopy, that can offer much needed quantitative information pertinent to the carrier recombination dynamics via both radiative and nonradiative processes, such as internal quantum efficiency, minority and majority carrier density, inter-band radiative recombination rate, minority carrier nonradiative recombination rate, defect center occupation fraction, defect center density, and minority and majority carrier capture cross-sections. Application examples for point and extended defects will be illustrated.

Short Bio:

Yong Zhang is the Bissell Distinguished Professor in the Department of Electrical and Computer Engineering at UNC-Charlotte. He earned his B.S. and M.S. degrees in Physics from Xiamen University, followed by a Ph.D. in Physics from Dartmouth College. Prior to joining UNC-Charlotte in 2009, Dr. Zhang served as a Senior Scientist at NREL. His research spans electronic and optical properties of semiconductors and associated nanostructures, organic-inorganic hybrid materials, impurity and defects in semiconductors, and innovative materials and device architectures for applications in optoelectronics, energy, and electronic-photonic integrated circuits. He has over 260 publications, 6 patents, and more than 10,000 citations. He is a Fellow of American Physical Society.