Semiconductor Nanocrystal Optoelectronics using Colloidal Quantum Wells for Lighting and Displays: *Pushing the Limits, Breaking Records*

Hilmi Volkan Demir

NTU Singapore – Nanyang Technological University, School of Electrical and Electronic Engineering, School of Physical and Mathematical Sciences, School of Materials Science and Engineering, Singapore

Bilkent University UNAM, Department of Electrical and Electronics Engineering, Department of Physics, Institute of Materials Science and Nanotechnology, Ankara, Turkey

hvdemir@ntu.edu.sg, volkan@bilkent.edu.tr

Lighting and displays are integral parts of human activities and economic development. Semiconductor nanocrystals, now offering a market volume exceeding 1 Billion Euros annually, have attracted great interest in quality lighting and displays in the last decade. Such colloidal semiconductors enable enriched color conversion essential to superior lighting and displays. These colloids span different types and heterostructures of semiconductors, starting in the form of colloidal quantum dots about three decades ago and extending to the latest sub-family of nanocrystals, the colloidal quantum wells, in the last decade. In this talk, we will present most recent examples of photonic structures and device architectures using the colloidal quantum wells [1-5] for lighting and displays. Also, we will present a powerful, large-area, orientation-controlled self-assembly technique for orienting these colloidal quantum wells either all face down or all edge up [6]. We will demonstrate three-dimensional constructs of their oriented self-assemblies with monolayer precision [7]. Among their extraordinary features important to applications in lighting and displays, we will show record high efficiency from their colloidal LEDs [8] and record gain coefficients from their colloidal laser media [9] using heterostructures [2-5] and/or oriented assemblies [6,7] of colloidal quantum wells. Given their current accelerating progress, these solution-processed quantum wells hold great promise to challenge their epitaxial thin-film counterparts in semiconductor optoelectronics in the near future.

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