Double Heterojunction Nanorods: From Light-Emitting Diodes to Advanced Display Concepts

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Novel materials which enable electronics manufacture helps to drive the innovation cycles underlying the Information Age. I will describe collaborative research efforts with the University of Illinois Urbana-Champaign on novel emissive QLED displays based on heterojunction nanoparticles which can display bidirectional functionality (pixels capable of both light emission and light detection) at very low voltages. Advances in emissive quantum dots have led to efficiencies and brightness rivaling evaporative those of OLED displays. The novel double-heterojunction nanorod LEDs, which due the ability to design near optimal band offsets, assist in facile charge transport of both holes and electrons with minimal interfacial resistance, giving excellent charge balance characteristics. One application we will highlight will be the development of highly novel bidirectional display devices which allow both emission and light detection with the same pixels. These new display devices should allow for unique interfaces and interactivity with users leading to new functionality that could have commercial application in the design of future electronic devices for consumer and data markets.

Dr. Trefonas is a Corporate Fellow in The Dow Chemical Company, where he works within the Dow Electronic Materials Business Group. His research career began at Monsanto Electronics Materials Company, and then to co-founding a start-up company called Aspect Systems Inc. which acquired lithographic chemicals technology spun off from Monsanto. He continued in electronic materials R&D as his career moved via acquisitions by Shipley Company, Rohm and Haas Company, and to the Dow Chemical Company. Prior to graduate school, he was also the creator of several commercial computer games which were popular on early microcomputer platforms. Dr. Trefonas earned his PhD in Inorganic Chemistry with Prof. Robert West at the University of Wisconsin-Madison in 1985, and his BS in Chemistry at the University of New Orleans in 1980.

Dr. Trefonas made major contributions to the development of many successful Dow products which are used in the production of integrated circuits spanning multiple device design generations from 2 micron to 16 nm node technologies. These include photoresists, antireflectant coatings, underlayers, developers, ancillary products, and environmentally safer ‘green’ products. These products have been used in the manufacture of many generations of electronic items. The subjects of his scientific publications include photopolymer and photoresist chemistry, block copolymers and self-assembly, nanoparticle based displays, organic antireflectants, lithographic fundamental mechanisms, organosilicon polymers, and a variety of other topics within the field of materials science. He is an inventor on 80 granted US patents, and is an author of 110 journal and technical publications, and has given many plenary, keynote and invited presentations at conferences in the last few years. He also was recently been awarded the 2016 Perkin Medal for outstanding contributions to industrial chemistry, the 2014 ACS Heroes of Chemistry Award and the 2014 SPIE Willson Award, and was named a Fellow of The International Society for Optics and Photonics (SPIE) in 2018.