Semiconductor Quantum Science and Technology for Optoelectronics Devices from deep UV to THZ Past, Present and Future trends

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We are living in an unprecedented era of hyper-connectivity that is redefining our society and culture—and this has only just begun. From data collection and search engines to e-commerce, the internet has become the ubiquitous cloud that is connecting every aspect of our daily lives. Powering this cloud is an intricate web of globally connected data centers, each filled with thousands of computers networked together and linking us to a seemingly unlimited breadth of information and content. Nowadays, our mobile devices provide various forms of connectivity that allows instant access to thousands of applications and all of the internet. The resulting explosion in data is staggering and the amount of data created globally will roughly double every two years. Meanwhile, healthcare as our parents knew it is being transformed. New wearable devices can track heart rate, glucose levels, and food intake, helping doctors and caregivers monitor the biometrics of their patients—regardless of their location—to identify patterns that may lead to more successful treatments. Even more leading-edge: there are Wi-Fi chips meant to be swallowed to deliver a raft of information instantly to doctors. All of these advances offer unparalleled possibilities to enrich the lives of people around the world while generating growth and opportunity across the global economy. But none of this would be possible without a quantum mechanical understanding of atoms—the most fundamental building block of our modern age. Nature offers us a full assortment of atoms, but Quantum engineering is required to put them together in an elegant way to realize functional structures not found in nature. A particularly rich playground for Quantum era, is the so-called III-V semiconductors, made of atoms from columns III and V of the periodic table, and constituting compounds with many useful optical and electronic properties. Guided by highly accurate simulations of the electronic structure, modern semiconductor quantum devices are literally made atom by atom using advanced growth technology to combine these materials in ways to give them new proprieties that neither material has on its own. Modern mastery of atomic engineering allows high-power and highly efficient functional devices to be made, such as those that convert electrical energy into coherent light or detect light of any wavelength and convert it into an electrical signal.

This talk will present the future trends of latest world-class research breakthroughs that have brought semiconductor quantum optoelectronics engineering to an unprecedented level, creating IR light detectors and emitters over an extremely wide spectral range from 0.2 to 300 microns. As well as their integration with Si photonics.

Biography:

Manijeh Razeghi received the Doctorate d'état ES Sciences Physiques from the Université de Paris, France, in 1980. Manijeh Razeghi was the Head of the Exploratory Materials Laboratory at Thomson-CSF (France) during the 80's where she developed and implemented modern metalorganic chemical vapor deposition (MOCVD) vapor phase epitaxy (VPE), molecular beam epitaxy (MBE), GasMBE, and MOMBE for entire compositional ranges of III-V compound semiconductors from deep UV to THZ. Developing these tools was fundamental in enabling her to achieve high purity semiconductor crystals with a consistency and reliability that was often unmatched, thereby leading to new physics phenomena in InP , GaAs, GaSb, and AlN based semiconductors and quantum structures. She realized the first InP Quantum wells and Superlattices and demonstrated the marvels of quantum mechanics in the low dimensional world. She joined Northwestern University, Evanston, IL, as a Walter P. Murphy Professor and Director of the Center for Quantum Devices in

Fall 1991, where she created the undergraduate and graduate program in solid-state engineering.

She has authored or co-authored more than 1000 papers, more than 35 book chapters, and 20 books. Her current research interest is in nanoscale optoelectronic quantum devices. From deep UV to Thz.

Dr. Razeghi is a Fellow of MRS, IOP, IEEE, APS, SPIE, OSA, Fellow and Life Member of Society of Women Engineers (SWE), and Fellow of the International Engineering Consortium (IEC). She received the IBM Europe Science and Technology Prize in 1987, the Achievement Award from the SWE in 1995, the R.F. Bun shah Award in 2004, IBM Faculty Award 2013, the Jan Czochralski Gold Medal in 2016, the 2018 Benjamin Franklin Medal in Electrical Engineering, LSA 10th Anniversary Outstanding Contribution Award, and many best paper awards. She is an elected life-Fellow of SWE, IEEE, and MRS. She is honored as a member of Academy of Europe.