National Institute of Technology Karnataka, Surathkal
Department of Physics
is organizing one-day International Webinar on

Recent Development in Materials, Device and Applications

Date: Oct 13, 2020

Patron: Prof. K. Uma Maheshwar Rao, Director NITK Surathkal

Inaugural address: Dr. Ajith K. M., HoD Physics (10:30 am)

Presidential address: Prof. K. Uma Maheshwar Rao, Director (10:45 am)

Speaker: Prof. Digbijoy N. Nath, IISc Bangalore (11:00 am)

Title: Gallium Oxide Deep-UV Photodetectors

Speaker: Prof. Samaresh Das, IIT Delhi (3:00 pm)

Title: Silicon Quantum Information Technology: Progress and Prospects

Speaker: Prof. Marc Cahay, University of Cincinnati USA (4:15 pm)

Title: Field Emission From Straight and Looped Carbon Nanotube Fibers

Convener: Dr. Partha P. Das

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Gallium Oxide Deep-UV Photodetectors

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Abstract: Gallium oxide is an emerging ultrawide band gap semiconductor with attractive material properties for enabling next generation power devices and deep-UV opto-electronics. In this talk, the status and promises of gallium oxide devices will be presented along with their challenges. The talk will then focus on deep-UV photodetectors based on gallium oxide, in particular on the recent advances made in this area in terms of lateral as well as vertical detectors, including self-powered devices and arrays. Finally, the possibility of enabling hybrid, tunable broadband UV sensors based on gallium nitride and gallium oxide will be discussed.

Biography: Prof. Digbijoy N. Nath completed his B.E. in Electrical & Electronics at BITs Pilani and PhD in Electrical Engineering at Ohio State University, Columbus. He is currently an assistant professor at Indian Institute of Science (IISc), Bangalore since 2014. His areas of research include Gallium Nitride based power transistors and UV detectors, Gallium Oxide and emerging device technologies.

Silicon Quantum Information Technology: Progress and Prospects

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Abstract: Silicon quantum information technology is appearing as a promising approach due to size of the qubits, high quality quantum gates and the ability of the existing CMOS fabrication to make billions of identical devices. The silicon as a host material for quantum information processing has been recently demonstrated for long-lived, high-fidelity silicon qubits and multi-qubit gates. The prospects for development of silicon single electron spin and charge qubit will be discussed in this talk. Furthermore, the scalable quantum information architecture will be discussed in terms of long-range qubit coupling, robust and scalable fabrication processes and schemes to correct errors.

Biography: Prof. Samaresh Das is an Associate Professor at the Centre for Applied Research in Electronics (CARE), IIT Delhi, India. He received his M. Sc. and PhD degrees, both in Physics, from IIT Kharagpur, in 2005 and 2011, respectively. During his doctoral study at IIT Kharagpur he worked on Ge quantum dot based floating gates, light emitters and photo-detectors on silicon substrate. Subsequently, he worked as a researcher in the Ultimate Silicon Device Group led by Prof. Jean-Pierre Colinge at Tyndall National Institute, Ireland. There he worked on the fabrication and characterization of Junctionless Nanowire Trigate MOSFET. He worked as a Research Scientist at Hitachi Cambridge Lab-Cavendish Lab, University of Cambridge on Quantum Information Project for the development of scalable silicon charge qubit. In September 2014, he joined IIT Delhi as an Assistant Professor. Presently he is working on the development of efficient infrared photodetectors, THz electronic devices and quantum devices. He is a recipient of **Early Career Faculty Research Award** (2019, IIT Delhi), **Institute for Smart Structures and Systems (ISSS) Young Scientist** Award-2019, **Indian National Academy of Engineering (INAE) Young Engineer Award**-2017, and **MeitY Visvesvaraya Young Faculty Research Fellowship** Award.

Field Emission From Straight and Looped Carbon Nanotube Fibers

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Abstract: In an effort to characterize carbon nanotube fibers (CNFs) as efficient electron emission sources suitable for compact, high power, high frequency vacuum electronic devices, we have developed an exhaustive approach towards optimizing their field emission (FE) properties. In this talk, we will discuss how a platform of scientific enquiry geared towards a meaningful comparison between different CNF-based emitters can be developed. The platform envisages an iterative procedure involving (a) the growth, processing, and functionalization of CNFs, (b) full investigation of the CNF material properties *before* and *after* FE diagnosis, and (c) multi-scale modeling of FE properties, including self-heating, shielding effects and beam characteristics in the CNFs and in the emitting carbon nanotubes at the fiber apexes. The modeling would be applicable to a wide variety of CNFs and wire-like sources, and would provide essential feedback to the growth, processing, and functionalization of CNFs, in order to optimize their FE properties, especially long-term stability, low noise, maximum emission current, current density, emittance, and brightness.

This talk will report on the characterization of the FE properties of both straight and looped fibers, including COMSOL simulations of their FE characteristics. Recent experiments unveiled that looped CNFs lead to field emitters with giant apex field enhancement factors. In this case, we have found that the field electron emission from a looped CNF occurs from the well-rounded fiber loop and the presence of micro-fibrils protruding from the surface close to its apex.

Biography: Prof. Marc Cahay received his B.S. in Physics from the University of Liege, Belgium in 1981, his M.S. in Physics and his Ph.D. in Electrical Engineering from Purdue University in 1986 and 1987, respectively. He joined the Department of Electrical Engineering and Computer Science at the University of Cincinnati, Ohio as an Assistant Professor in 1989 and was promoted to the rank of Associate Professor in 1995 and Full Professor in 2000. In 1991, he received his first research grant from the National Science Foundation under the Research Initiation Program. Following this he received numerous awards from various funding agencies for his outstanding contribution to research and teaching. His area of research involves semiconductor spintronics, field emission from carbon nanotube fibers, graphene based bolometers and novel ultra-compact plasmonic nanodevices for waveguiding and nanolasing. He regularly publishes his research in journals of Nature Publishing Group, American Institute of Physics, American Physical Society, etc. He also co-authored a popular textbook *Introduction to Spintronics*, which has been widely acclaimed by students and teachers across the globe. Prof. Cahay is a Fellow of IEEE, American Physical Society, Electrochemical Society and American Association for the Advancement of Science.
