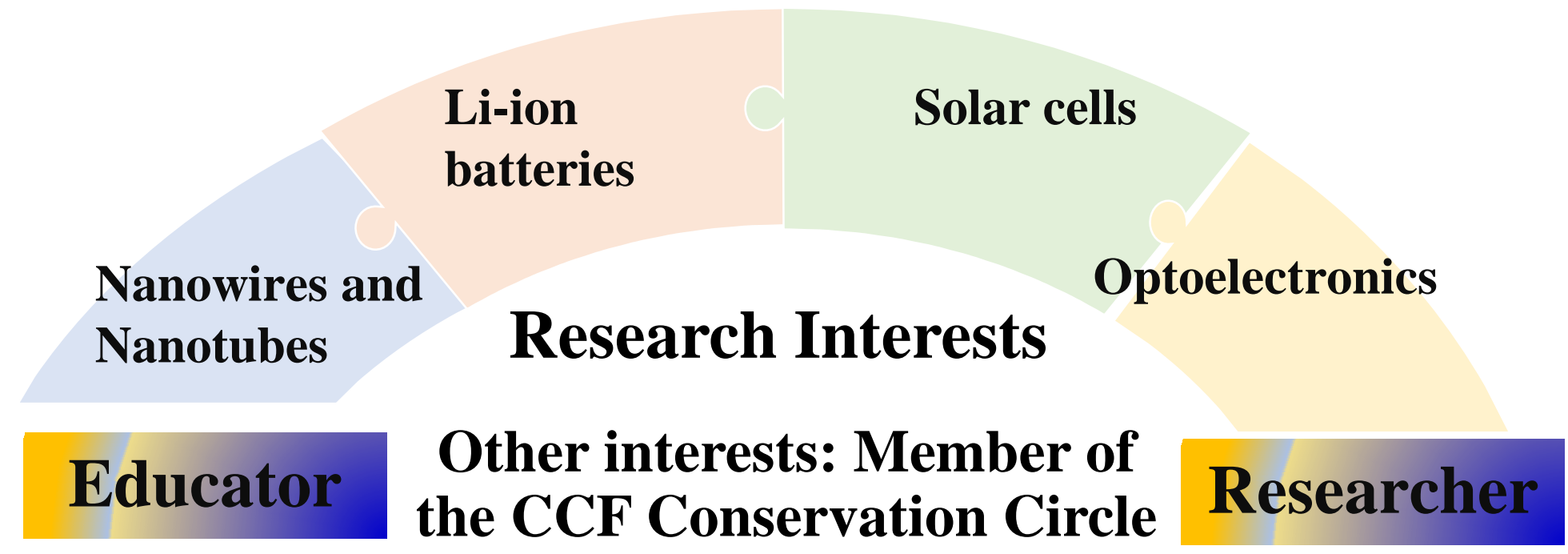


Dr. Amit Verma, The Educator of the Month, December 2022



Dr. Amit Verma

- ✓ Full Professor of Electrical Engineering;
- ✓ Award-winning author of books in literary fiction
- ✓ “Professor of the Year” award from the 2015 graduating class
- ✓ TAMUK Faculty Senate President 2015
- ✓ Co-holder of 7 patents and 1 pending patent
- ✓ Notable inventions – a new class of microwave antennas; new power switching device
- ✓ Co-authored about 60 peer-reviewed research papers – work has received wide media coverage
- ✓ Opinion Contributor for Corpus Christi Caller Times and other news publications

Select Works:

1. Patent: A. Verma, F. Urbani, and D.W. Stollberg, “Integration of an Aperture-Coupled Nanofilm Microstrip Antenna in an Integrated Circuit Chip,” United States Patent and Trademark Office, No. 9,679,828, June 2017
2. Patent: A.C.S. Ratcha, A. Verma, R. Nekovei, and M.M. Khader, “Heterojunction Schottky Gate Bipolar Transistor,” United States Patent and Trademark Office, No. 9,793,430, October 2017;

2010 ANNUAL REPORT

THE PROBLEM SOLVERS

GTRI

Georgia Tech Research Institute

Problem. Solved.

Helping Architects Preserve Digital Files

Researchers at GTRI are leading the charge in advanced file-format research with the National Archive of the United Kingdom. The effort could enhance worldwide capabilities for managing and archiving the vast trove of digital content that the organization has begun.

Improving network ability to compress and access hundreds of different computer file formats is critical in the digital age. Increasingly, users store large quantities of documents and other content in a variety of algorithms. Collaborating among the different formats is the key to efficient data storage.

For existing formats, it is most convenient to compress using the algorithms such as ZIP or PDF. GTRI researchers are developing techniques designed to identify the distinctive internal signatures of files – work originally done for U.S. government intelligence agencies.

Improving Food Quality with Imaging

Food companies that require tight control over food quality should benefit from a new GTRI-developed system that automatically reports product flaws on the production line and adjusts user management to prevent production of defective goods.

By reflecting an incoming infrared laser beam, particles further inspection and manual adjustment of line parameters, the system will reduce the amount of off-quality product produced. Due to control variation at the baking process, along with storage, moisture, fungus, yeast, and aging, technology systems, BakedTech, a program system has been operating in a testing facility for more than a year.

In the future, the imaging system could be adapted to control the quality of other bakery products, such as biscuits, cookies, crackers, bread and pastries.

Developing Radio Frequency “Nano Antennas”

A new class of nanoscale antennas that use carbon nanotubes and nanowires will make their way into the microelectronics of future generations for defense and homeland security applications. The design, developed by teams of Texas A&M University and Georgia Tech researchers, may have applications for wireless networks.

Being these antennas are only a few micrometers long, and require the same amount of power as a conventional antenna, these antennas could be used in systems-on-chip, space and other specialized applications.

Coating Microelectronics with Silver-Diamond Composite

GTRI researchers are pioneering a technique to coat microelectronics with a silver-diamond composite. The silver-diamond composite is a highly conductive and thermally stable material that can be used to coat microelectronics. The work is based on producing a composite film of silver-diamond nanowires (SDN) on a silicon substrate. The use of diamond is believed to be the most effective way to coat microelectronics with silver. The material could help improve the performance and reliability of the microelectronics.

Strain controls spontaneous emission in silicon nanowires

The direct bandgap due to quantum confinement, adjustable bandgap, sensitivity to surface ligands and mechanical excitation, and compatibility with mainstream silicon technology of silicon nanowires makes them excellent candidates for optoelectronic devices. Now, researchers at the University of Waterloo (Waterloo, ON, Canada), in collaboration with Texas A&M University-Kingsville and University of Washington-Seattle, have discovered that uniaxial strain can modulate the spontaneous emission of photons in silicon nanowires—a finding that improves the potential for these devices to function efficiently in a variety of optoelectronic applications, including a mechanism for lasing.

Using silicon nanowires ranging in diameter from 1.7 to 3.1 nm that have a direct bandgap at 0% strain, the researchers showed that compressive strain increased spontaneous emission time by one to two orders of magnitude. This occurs due to either the change of wave-function symmetry or direct-to-indirect bandgap conversion. To create a population inversion in silicon nanowires, current can be injected in a compressively strained nanowire with an indirect bandgap in which the light emission is a slow second-order process (mediated by phonons). During strain release or by applying tensile strain, the initial population can scatter into the direct sub-band via fast electron-phonon scattering processes. This initiates lasing if the nanowire is embedded in a suitable mode-enhancing cavity. Contact Daryoush Shirir at dshir@uwaterloo.ca.

Laser Focus World www.laserfocusworld.com August 2012 9

Possibility of spontaneous optical emission in silicon nanowires

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Texas A&M-Kingsville professors may be first to listen for electrons

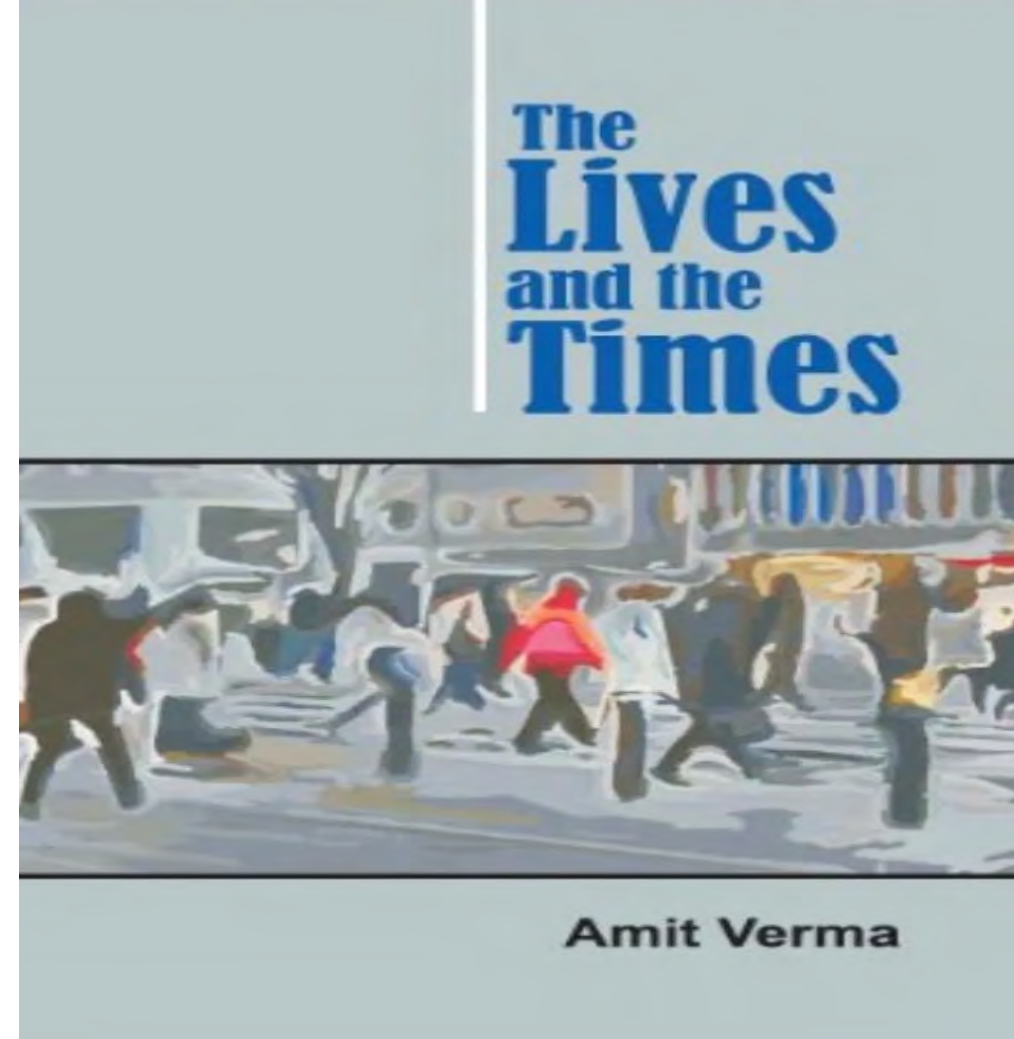
Posted on Friday, April 23, 2021



From left Dr. Reza Nekovei and Dr. Amit Verma, both professors in the electrical engineering and computer science department.

KINGSVILLE (April 23, 2021) — Drs. Amit Verma and Reza Nekovei, professors in the electrical engineering and computer science department at Texas A&M University-Kingsville, are listening. In a new paper, recently published in the Nature journal, *Scientific Reports*, Verma and Nekovei say it is now possible to hear electrons as they travel through a device.

In their paper, *On the feasibility of hearing electrons in a 1D device through emitted phonons*, they claim that electrons traveling through a one-dimensional material like a carbon nanotube, causes vibrations in the atoms in the carbon nanotubes with sufficient power to be detected by modern instruments. They were joined in the



http://dx.doi.org/10.1109/EMC.2010.5692000_12_15_EngineeringProfessorInvolvedCreatingNewClassAntennas

For Immediate Release

Engineering Professor Involved in Creating a New Class of Antennas

BROWNSVILLE, TEXAS — DECEMBER 15, 2010 — A University of Texas at Brownsville and Texas Southmost College faculty member is working with researchers in Georgia and Texas to invent a new type of microwave antenna that involves nanomaterials.

Dr. Fabio Urbani, an associate professor of electrical engineering in the Department of Engineering, is working with Dr. Amit Verma, an assistant professor of electrical engineering at Texas A&M University Kingsville and Dr. David Stollberg, a research engineer at the Electro-Optical Systems Laboratory at the Georgia Tech Research Institute in Atlanta.

The research team has built a microwave antenna using a very thin film of iron, as well as another that uses carbon nanotubes. Microwave antennas made of nanomaterials can potentially revolutionize aircraft and satellite communications, mobile radio and biomedical applications.

“The thickness of the iron film is only about 10 nanometers while the diameter of the carbon nanotubes is about 20 nanometers,” said Urbani. “As a comparison, this is about a thousand times smaller than the thickness of your hair. These antennas have not only demonstrated outstanding performance and reliability, but also very interesting behavior compared to traditional microwave antennas.”

Urbani said the thin-film antenna showed an ability to transmit and receive data over a wide continuous range of frequencies. The antenna with carbon nanotubes showed the potential to work at lower frequencies compared to a traditional antenna, without increasing its size – something that has always been a challenge

Development of the first set of microwave antennas from nanofilms and nanotubes.

EurekAlert!
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PUBLIC RELEASE 24-MAR-2018

Silicon breakthrough could make key microwave technology much cheaper and better

UNIVERSITY OF WATERLOO

Researchers using powerful supercomputers have found a way to generate microwaves with inexpensive silicon, a breakthrough that could dramatically cut costs and improve devices such as sensors in self-driving vehicles.

“Until now, this was considered impossible,” said C.R. Sekulkumar, an engineering professor at the University of Waterloo who proposed the concept several years ago.

High-frequency microwaves carry signals in a wide range of devices, including the radar units police use to catch speeders and collision-avoidance systems in cars.

The microwaves are typically generated by devices called Gunn diodes, which take advantage of the unique properties of expensive and toxic semiconductor materials such as gallium arsenide.

When voltage is applied to gallium arsenide and then increased, the electrical current running through it also increases – but only to a certain point. Beyond that point, the current decreases, an oddity known as the Gunn effect that results in the emission of microwaves.

Lead researcher Daryoush Shirir, a former Waterloo doctoral student who now works at Chalmers University of Technology in Sweden, used computational nanotechnology to show that the same effect could be achieved with silicon.

The second-most abundant substance on earth, silicon would be far easier to work with for

Possibility of GUNN effect in silicon nanowires

Microwave Journal

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Pat Hindle, MWJ Editor

Pat Hindle is responsible for editorial content, article review and special industry reporting for Microwave Journal magazine and its web site in addition to social media and special digital projects. Prior to joining the journal, Mr. Hindle held various technical and marketing positions throughout New England, including Marketing Communications Manager at M&C/CDI (Type Electronics), Product Manager at Alpha Industries (Spartan), Program Manager at Raytheon and Project Manager/Quality Engineer at MIT. Mr. Hindle graduated from Northeastern University Graduate School of Business Administration and holds a BS degree from Cornell University in Mechanical Science Engineering.

Silicon Enters the Realm of Microwave Oscillators by Showing Gunn Effect

Contributed by Daryoush Shirir

May 2, 2018

I recently read this very interesting work about the Gunn effect in Si devices sent to me by Daryoush Shirir:

Imagine an experiment in which you increase the voltage across a piece of a semiconductor until the Gunn effect occurs and you record the increasing current as a result. After passing a threshold voltage you notice roll off and current decrease. Why? Because some electrons gained enough energy to move to a higher energy band which has higher effective mass or in another language a band in which electrons have lower velocity. The transfer of electrons from a fast band to a slow band reduces their average velocity. Hence increasing the voltage causes a drop in current or in technical terms negative differential resistance (NDR). This phenomenon is known as Gunn or Gunn-Hauser effect and it was discovered independently by Gunn and Hauser in GaAs and other related III-V compounds during 1950s. This effect was exploited in devices called Gunn diodes for many decades as an essential component in 10-100 GHz oscillators for radar applications. The electric loss in LC or cavity resonators is compensated by NDR of Gunn diode.

