



OPTOELECTRONIC NANODEVICE RESEARCH LABORATORY

Department of Electrical Engineering & Center for Advanced Electronics

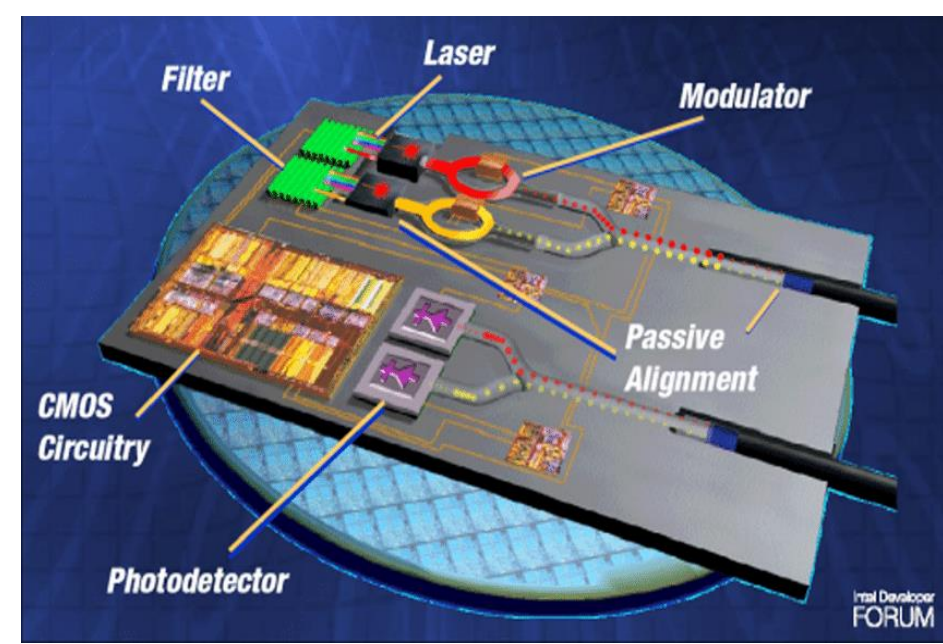
Indian Institute of Technology Indore

Group Leader : Prof. Mukesh Kumar



Motivation

Co-integrated CMOS-Photonics



Source: Science, 2010, 328,

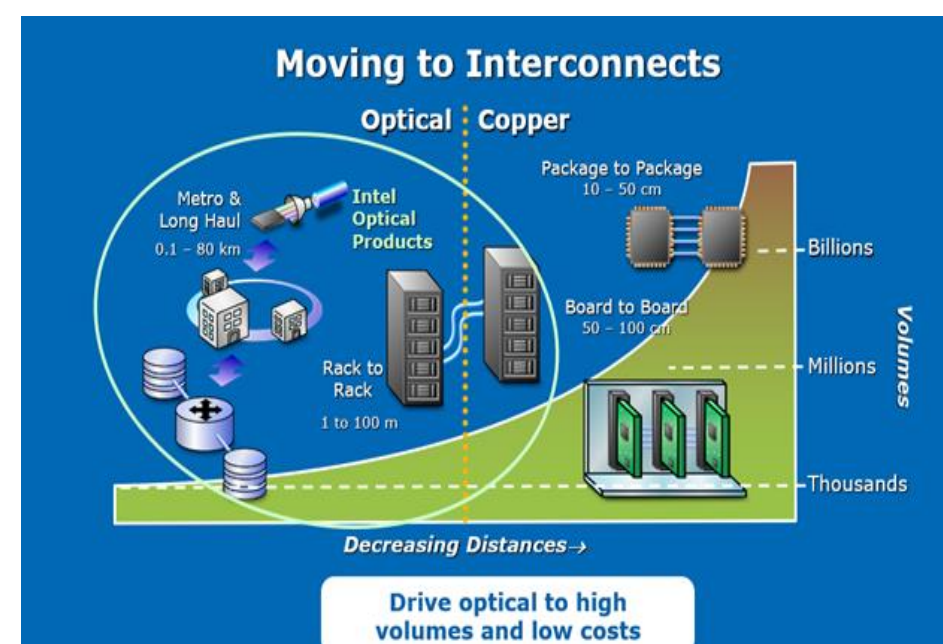
Integration of CMOS and photonic devices on the same chip

Smart Integration of Electronics and Photonics

(Enable each technology to play to its strength)

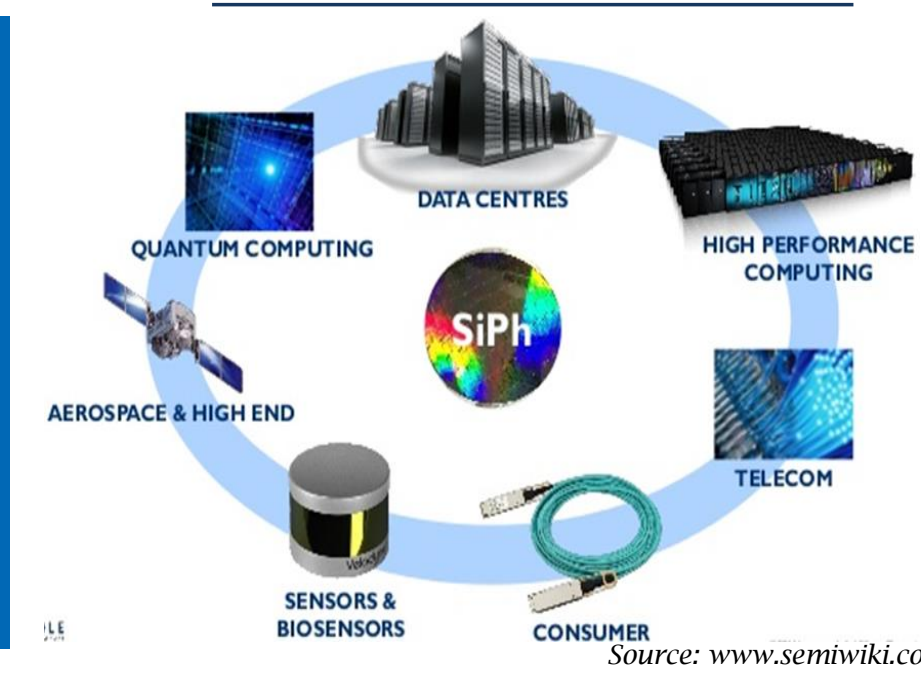
- CMOS's density and ability to perform complex processing
- Photonics outright speed and transmission capacity

Control and Manipulation of light at submicron/nanoscale remains an important requirement



Next-generation communication systems and data interconnects.

Silicon Photonics



Silicon photonics delivers all the components necessary to facilitate optical transmission and reception of data.

Scalability and Flexibility (Reconfigurable Photonic Networks)

Compact Devices with Tuning

Electrical Control, Tunable Delay and Low Power Tuning

Our Research Focus

Advanced Devices for Next Generation Optical Communication, Interconnects & Bio-chemical Sensing

For New Functionalities

For Improved Performance

- Photonic Crystals
- Metamaterials

Engineered material

Research Themes

- Optical Communication & Interconnects: **Silicon Photonics & Beyond**
- Semiconductor Optoelectronics & Optical Memory Technology
- Optical Bio-sensing, Quantum Photonic Devices
- Nanofabrication Technology
- Advanced Transistor Design

Key Devices: Our Focus

- Optical Modulator, Nanophotonic Switches
- Photodetector
- Passive Devices: Coupler, Waveguide, Filter
- Bio-chemical Sensors
- Optical Generation of RF/Microwaves

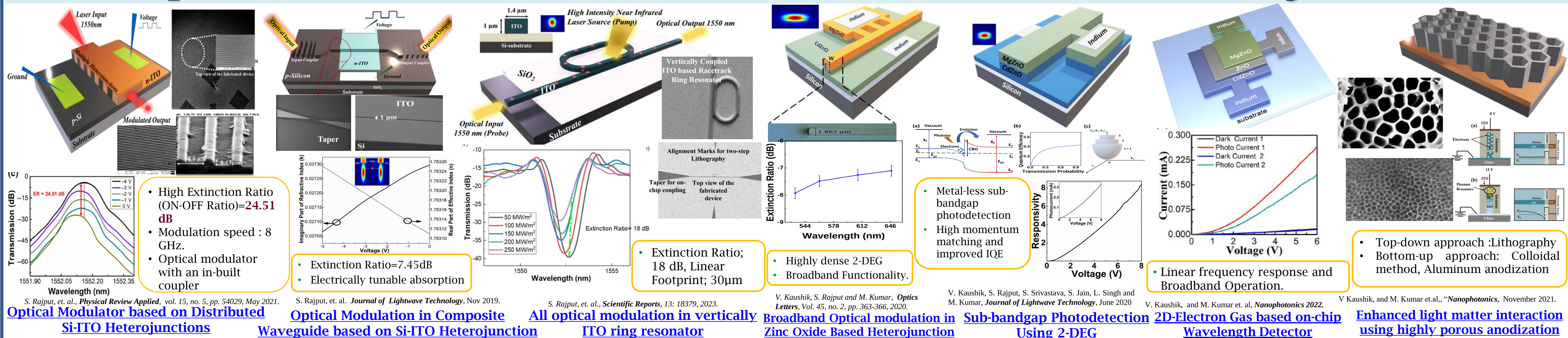
Outlook

- Miniaturization
- CMOS Compatible Process
- Beyond Silicon
- Semiconductor Heterojunctions
- Advanced Transistors: Optical..

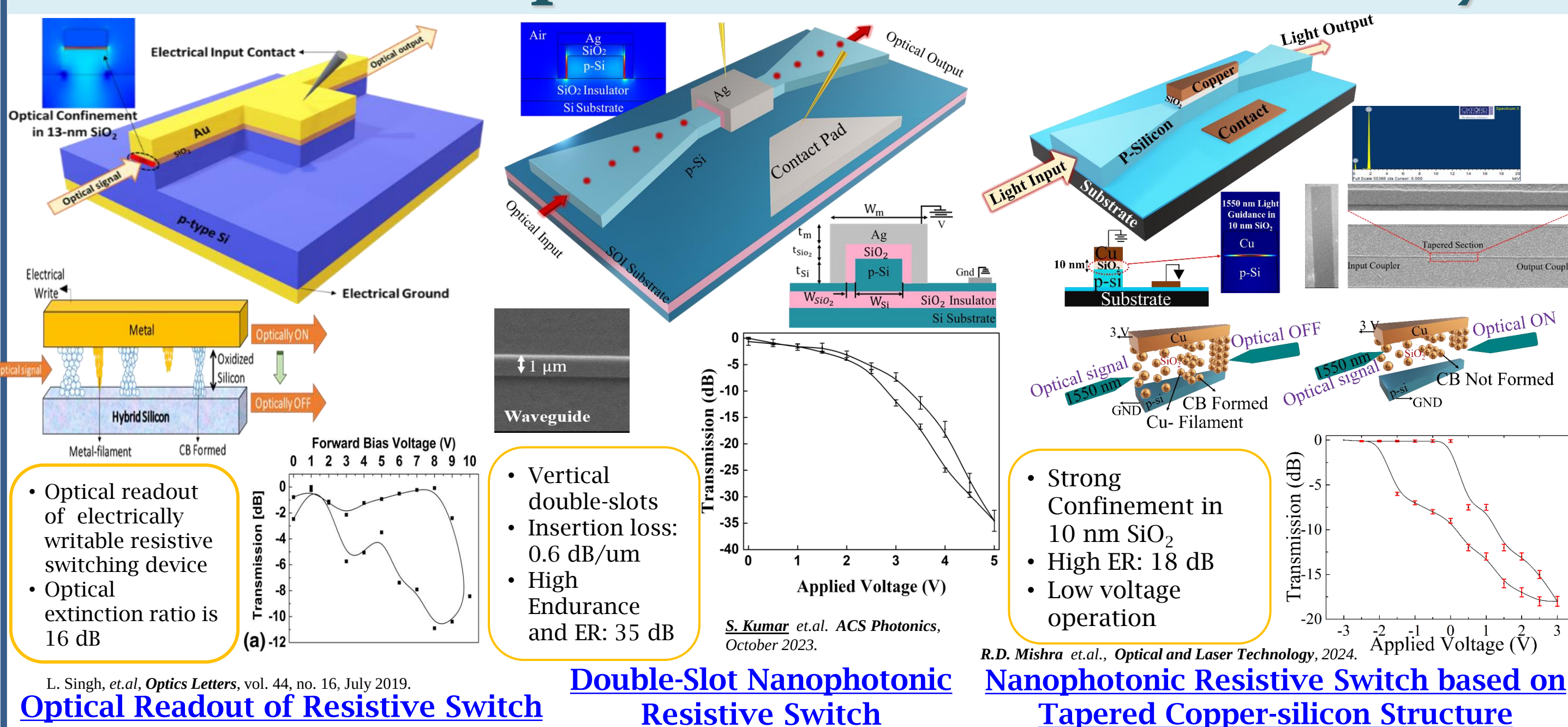
Applications

- Broadband Communication, Fibre Optic Networks
- Optical Interconnects, Computing and Information Storage
- Bio-Chemical Sensing, Optical Detection of Protein Biomarkers/Diseases
- Optoelectronic Power Devices
- LiDAR (Light Detection and Ranging)

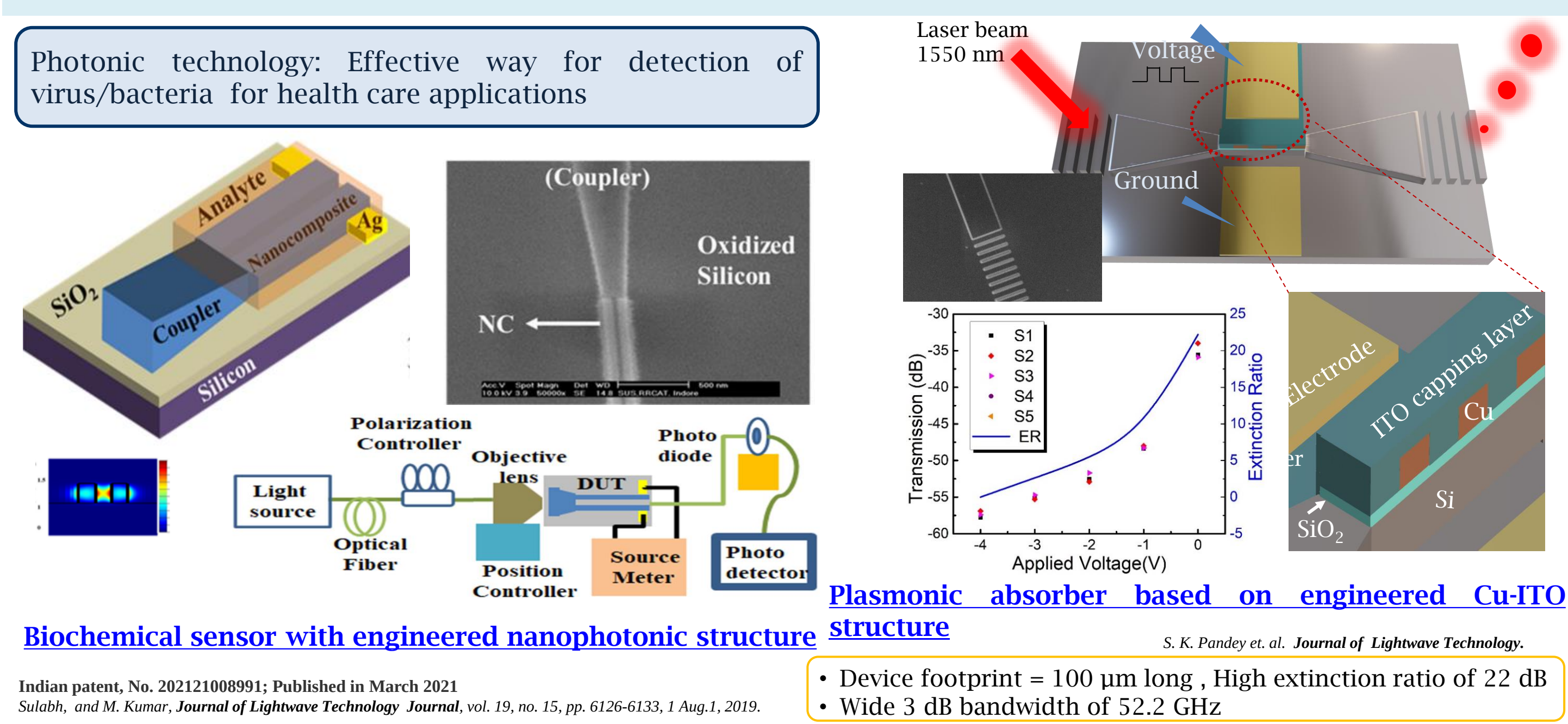
Chip-Scale Photonic Devices based on Semiconductor Heterojunctions



Silicon Nanophotonic Resistive Memory



Biochemical Sensors and Tunable Absorbers



Collaborators

- Massachusetts Institute of Technology (MIT), USA
- Purdue School of Engineering & Technology, IUPUI, USA
- University of Florida, Florida, USA
- University of Strasbourg, Strasbourg, France
- Raja Ramanna Centre for Advanced Technology, Indore
- Bharat Electronics Limited
- Centre for Development of Telematics

Funding Agencies

- Ministry of Electronics and Information Technology (MEITY)
- Department of Science and Technology (DST)
- Defence Research and Development Organization (DRDO)
- Science and Engineering Research Board (SERB)
- Council of Scientific and Industrial Research (CSIR)
- Oxford Instruments

Research Facilities

- Fabrication / Process Facilities**
 - Maskless Lithography
 - Fume hood with supporting accessories
 - RF/DC Sputtering
 - Digital Microscope and 3D Surface Profiler
 - Annealing Furnace & Anodization Setup
 - Coating & Wet Process facility
- Device Measurement Facilities**
 - Optical Spectrum Analyzer Microscope
 - Tunable & DFB Bench Top LASER Source
 - Optical Component Analyzer
 - High Speed Photodetector
 - Optical Fiber Accessories
 - Photodiode & Photo Amplifier
- Simulation Package**
 - COMSOL Multiphysics
 - Lumerical MODE, CHARGE & FDTD
 - FIMMWAVE & FIMMPROP
 - Grating Solver

Research Scholars



Group Alumni (Graduated PhDs)

