North Carolina Central University and NASA MIRO University Research Center for Aerospace Device Research and Education

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- **University Corporate Structure:** Board of Governors, President, Board of Trustees, Chancellor, and Executive Assistant, Director of Internal Audit, Chief of Staff, Director of Government and Community Relations, Director of Title III, University legal Counsel, Director of Athletic, Chief Human Resources, Chief Information Officer, Provost and Vice Chancellor for Academic Affairs, Vice Chancellor of Student Affairs, Vice Chancellor for Research and Economic Development, Vice chancellor of Institutional Advancement, Vice Chancellor for Administration and Fiancé, Deans, Centers directors - Please see attached document
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- **Certificates, Registrations, and Accreditations**: **Athletic Training** (Department of Physical Education): Commission on Accreditation of Athletic Training Education; **Business:** Association of Collegiate Business Schools and Programs, Association to Advance Collegiate Schools of Business; **Chemistry**: American Chemical Society; **Communication Disorders** (School of Education): American Speech—Language—Hearing Association; **Counseling** (School of Education): Council for Accreditation of Counseling and Related Educational Programs; **Criminal Justice:** North Carolina Criminal Justice Education and Training Standards Commission; **Dietetics** (Department of Human Sciences): Commission on Accreditation for Dietetics Education; **Education:** National Council for Accreditation of Teacher Education, North Carolina Department of Public Instruction; **Environmental, Earth and Geospatial Sciences**: National Environmental Health Science & Protection Accreditation Council; **Geography and Earth Sciences** (Department of Environmental, Earth, and Geospatial Sciences): University Consortium for Geographic Information Science; **Hospitality and Tourism Administration (**School of Business): Accreditation Commission for Programs in Hospitality Administration; **Law**: American Bar Association; **Library and Information Sciences:** American Library Association; **Nursing:** North Carolina Board of Nursing, National League for Nursing Accrediting Commission; **Parks and Recreation Management** (Department of Physical Education and Recreation): National Recreation and Park Association / American Association for Physical Activity and Recreation; **Physics:** American Physics Society; **Public Health Education**: Society of Public Health Education – American Association for Health Education; **Social Work:** Council on Social Work Education; **Theater**: National Association of Schools of Theater**; Radioactive materials License** #: 0320-0371-1; **Accelerator License** #: 032-0371-A1; **Animal Subjects Assurance:** # A3626-01 Expires: 1/31/2017; **Assurance of Compliance/Title IX:** (HHS 690): 01-14-2009.
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Capability Statement

NCCU is the nation's first state-supported public liberal arts college founded for African Americans, it is part of the University of North Carolina (UNC) system, prioritizes the development of innovative, high quality academic and research programs across the sciences, including such recent, large-scale initiatives as the creation of the: NASA University Research Center for Aerospace Device Research and Education, NSF-CREST Computational Center of Research Excellence, NSF Center - Partnership in Research in Engineering and Material Science, Biomedical/Biotechnology Research Institute, and the Biomanufacturing Research Institute & Technology Enterprise.

The NASA MIRO URC at NCCU has a **current contract** W91ISR-14-2-0001 with the Department of Defense ($550,000) on: Chemical and Bio-Sensors Operating at the Quantum Frontiers. The contract is for 3 years and the final product will be the high sensitivity and high selectivity biochemical detector.

The institution has specialized laboratories for:

Characterization of materials

1. Time resolved optical spectroscopy: The output of a Spectra Physics Spitfire regeneratively amplified laser system (800 nm, 2 mJ, 40 fs) is used for transient absorption and transient Rayleigh scattering measurements. This ultrafast spectroscopy is complemented by time-resolved photoluminescence using the same excitation and signal collection paths. These measurements are performed with nanosecond time resolution using time correlated single photon counting. Static photoluminescence and Raman mapping can be performed using the same optical system and a CW Argon ion laser.

2. Scanning probe / Optical microscopy system: This system, which integrates an AIST scanning probe microscope and a Horiba micro-Raman system, is capable of simultaneous scanning probe and optical microscopic characterization of samples. Lateral Force Microscopy (LFM), Piezo Force Microscopy (PFM), Phase contrast, Magnetic Force Microscopy (MFM), Single-Pass MFM, Electrostatic Force Microscopy (EFM), Single-Pass EFM, Scanning Kelvin Probe Microscopy (SKM), Scanning Capacitance Microscopy, Scanning Tunneling Microscopy (STM), conductive AFM and near field optical microscopy using apertured fiber probes.

3. Scanning electron microscope / microbeam analysis: FEI NanoSEM 630 thermal field emission scanning electron microscope with low vacuum (up to 1.2 torr) and beam deceleration capabilities, backscattered electron detectors for high / low vacuum operation, and a transmitted electron detector. Energy dispersive x-ray spectroscopy (EDX) can be performed an Oxford X-Max 50 silicon drift detector, and a Channel 5 HKL system is available for transmitted and backscattered Kikuchi diffraction measurement to correlate local crystal structure / composition with optical properties in samples with alignment marks.

4. Time resolved mm wave conductivity: Time dependent transmission or reflection of an mm-wave beam (tunable from 110 – 170 GHz) generated by an ELVA-1 backward wave oscillator is measured using a Keysight KT-DSO90604A 6 GHz bandwidth, 20 GSa/s oscilloscope. Excitation pulses are supplied by either a Coherent Helios 532-1-50 laser (532 nm, up to 70 kHz repetition rate, pulse width < 700 psec), or the Spitfire ultrafast laser system described above. This system is capable of contact-free measurement of entire time dependent photoconductivity decay curves resulting from a single laser shot over time scales of up to

milliseconds with sub – nanosecond time resolution, and is currently used to study carrier dynamics in organic photovoltaics.

5. Electrical Characterization - A Deep Level Transient Spectroscopy system can be used for conventional DLTS and thermally stimulated current to measure energies and concentration of trap levels in semiconductors. A Hall Effect system is also available to determine carrier densities and mobilities. All measurements can be performed from 4.2K to 300K.

6. Photoemission electron microscopy – The UV-PEEM system is connected via a UHV sample transfer system to the custom gas source molecular beam epitaxy system, enabling in situ studies of nanostructure growth. The system has a demonstrated resolution of ∼10 nm. UV photons are provided either by a 100W Hg lamp, or the Duke Free Electron Laser.

7. Cyclic voltammetry system for electrochemical characterization of nanostructured carbon electrodes and graphene-metal oxide composites.

Growth Facilities

1. Gas source molecular beam epitaxy growth system – This custom built system designed for epitaxial growth of III – Nitride materials has a base pressure below 2 x 10-10torr, and contains three EPI Knudsen cells for gallium, aluminum and indium solid sources. The nitrogen source is ammonia gas. Reflection high energy electron diffraction (RHEED) and Auger electron systems attached to the growth chamber are available to monitor the growth process.

2. CVD systems for graphene and inorganic semiconductor nanowire growth – Two systems are available, one dedicated to graphene growth, and one dedicated to inorganic semiconductor nanostructure growth. These systems are built around tube furnaces capable of reaching 1100ºC with base pressures of 1 x 10-3 torr. Gas flow in each system is controlled by mass flow controllers, and pressure is automatically controlled by a downstream throttle valve. Substrates and materials for thermal evaporation in both systems can be transported into and out of the heated zone while the system is under vacuum using magnetically coupled carriers.

3. UHV pulsed laser / electron beam deposition chamber - This load locked chamber is used for growth of nanostructures by pulsed laser ablation contains a six target carousel and a heatable, rotating substrate holder. The system also has a low power electron beam deposition system used to deposit metal (Au, Al, Ag) and dielectric (SiO2, MgO) thin films.

4. Clean room factor x-1000 equipped with lithography, thin film deposition systems, cleaning and baking semiconductors systems, and material characterization.

Geophysics Laboratory: Includes seismic station and wave propagation laboratory, with the seismic database. The research is a collaborative effort between the NCCU Department of Environmental, Earth and Geospatial Sciences, the Center for Earthquake Research and Information (CERI) at the University of Memphis, TN and the Geography Department at Fayetteville State University, NC. The main objective of this project is to image the geological structure of the crust in the eastern United States with combined geophysical observations.

Pollution and atmospheric testing laboratory: Comprehensive surface to mid stratospheric humidity profile combining satellite microwave sounder retrieval study. Study Water Vapor

Continuum Absorption in Microwave Frequency Range from 10 to 300 GHz and dielectric properties of water and sea ice.

Nuclear Physics Laboratories: for low and medium energy nuclear physics in collaboration with DUKE-Triangle Universities Nuclear Laboratory, Jefferson National Laboratory, and Oakridge National Laboratory. NCCU also performs very sophisticated calculations and computer modeling of nuclear reactions and processes (few body rigorous calculations), and also nuclear reactor efficiency modeling. In addition this includes material testing for radiation hardens and damage.

Robotics laboratory: Design and development of algorithms that can facilitate improved (i) multiple robot localization, (ii) energy-efficiency and quality of service in heterogeneous robotics wireless networks, and (iii) action and human recognition in computer vision. We explore multi-robot/sensor localization, mapping and navigation, coordination of movement, design of collective behaviors for such tasks as large area exploration and data gathering, surveillance, autonomous ground, aerial and marine exploration vehicles, design and analysis of algorithms to implement and perform simulations for performance evaluation. We are developing a Sonar Sensor Model for Underwater Terrain Mapping utilizing a novel approach for building the occupancy grid map using sonar data.

Object Recognition Laboratory: In Face Recognition, we explore a Deep Learning Based Cross-modal Face Recognition to develop a novel algorithm to match thermal face images to the data sets containing visible light face images. In this work, convolutional neural networks (CNNs) are trained to extract and integrate face features shared by both modalities;
Robust iris segmentation is essential for non-cooperative iris recognition. We explore Iris Segmentation in Visible Wavelength Images using Recurrent CNNs. Compared with near infrared eye images, iris regions in visible wavelength images often contain more noise such as environment reflections and cast shadows. We propose a novel iris segmentation algorithm for noisy visible wavelength images. The central research problem we address is how to measure and analyze visual attention in a large three-dimensional space. The technologies have a great potential to benefit many areas, such as aviation simulation in various flight environments and coordination of visual attention for children with autism spectrum disorder.

Cyber security Laboratory: we perform Internet of Things (IoT) Mobile Cloud Security and Privacy and Vehicular Adhoc Network (VANET) Security and Privacy (active) to explore security and privacy issues of a new environment and provide efficient solutions and remedies using mathematical tools such as algorithms and applied cryptography;

Mobile Sensor Networking and Cyber Physical Systems Laboratory: to improve efficiency of networked robotics systems used in many applications, it is important to organize them according to their mission. The delay in these system is mainly due to the relative speed of the mobile agents. It is important to decide their trajectories to minimize such a delay. This project studies the near optimal trajectories of the mobile agents with the goal of minimizing the latency caused by them for various mission.

North Carolina Central University

2015-16 Organizational Chart