Establishing UCF as an anchor institution for research and education in advanced semiconductor technologies and nanofabrication

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CECS Dean Advisory Board Meeting
University of Central Florida
April 23, 2022
UCF President’s 2021-2022 Strategic Investment Program

Academic Excellence Fund
• To support big ideas and longer-term innovations that will have a substantial impact
• Seven million in recurring central funds and $21 million in central non-recurring funds will be invested, plus unit matching funds

Jump Start Fund
• Invests in one-time projects or purchases to amplify UCF’s impact
• Proposals could include requests for research infrastructure, facilities renovations under $2 million, equipment, temporary staff, etc.
• A total of $5 million of central university non-recurring funds
Importance of Nanofabrication Cleanroom Facilities

• There is arguably no STEM infrastructure as impactful as a versatile micro/nanofabrication cleanroom facilities

• There is a strong correlation between university research ranking in STEM fields and the capabilities of their cleanroom facilities

• For example, the 16 primary facilities that form the NSF-supported National Nanotechnology Coordinated Infrastructure (NNCI) include Stanford, Georgia Tech, Cornell, UT Austin, and Arizona State amongst others

• At top research universities, cleanroom facilities are truly multiuser (tens to over 100 PIs) and multidisciplinary and synergize different colleges and department programs
Status of Cleanrooms at UCF

• Centrally-operated cleanrooms are known as one of the best catalysts to synergize research among faculty from different colleges and department programs.

• UCF currently has three cleanroom facilities spread across three colleges (COP, CECS and COS).

• These previously balkanized facilities are now unified under a shared umbrella and are utilized by over 25 internal PIs and several external users including local industry.

• The UCF central cleanroom facility is directly operated and funded by the UCF Office of Research and administered by a joint faculty committee, comprised of three members from each of the three involved colleges.

• The fees collected from the users amount to roughly 20% of the operation cost of the center.
Shortcomings and Future Plans of Cleanrooms at UCF

• Equipment capabilities are limited or worn out
• Staff support is limited
• The UCF administration has agreed to establish a new 10,000 sq. ft. in the first floor of the to-be-built Research II Building
• The building has the second highest priority in the university masterplan

Why Not take Advantage of the UCF President Initiative?
Response to UCF President’s 2021-2022 Strategic Investment Program

• Name of co-PIs:

• **College of Optics and Photonics:** Sasan Fathpour, Peter Delfyett, Patrick LiKamWa, and Kyle Renshaw

• **College of Engineering and Computer Science:** Reza Abdolvand, Parag Banerjee, Hyoung Jin Cho, Kevin Coffey, Kris Davis, Xun Gong, Tengfei Jiang, Swaminathan Rajaraman, Tania Roy, and Kalpathy Sundaram

• **College of Sciences:** Robert Peale, Enrique del Barco, Debashis Chanda, Arkadiy Lyakh, and Masahiro Ishigami

The combined research funding received during the past 3 years by the 19 listed co-PIs on this proposal is more than $18.5M
Two Funded “Cleanroom” Proposals (Total of ~ $7,000,000)

Academic Excellence Program

• **Cleanroom Equipment Budget** (Total of $1,785,000 nonrecurring fund from UCF):
  • Advanced Electron-Beam Lithography System ($1,700,000 with $1,495,000 from UCF)
  • E-Beam Evaporator System for Metal Deposition ($280,000 with $260,000 from UCF)
  • Plasma-Enhanced Chemical Vapor Deposition (PECVD) Chamber ($255,000 with $30,000 from UCF)
• **Six UCF Faculty Positions** ($1,150,000 recurring salaries and $3,800,000 startup fund):
  • More details later
• **Two Cleanroom Technical Staff Positions** ($250,000 recurring salaries from UCF):
  • Manager of UCF’s Nanofabrication Cleanroom Facilities
  • Equipment Maintenance Engineer

Jump Start Program

• **Equipment Acquisition**: A direct-write (maskless) photolithography tool ($534,000 with $430,000 from UCF)
Major Equipment to Be Acquired

Raith EBPG5150 Plus - Ultra High Performance e-Beam Writer

AJA International’s ATC Series e-Beam Evaporator

DWL 66+ maskless photolithography system from Heidelberg, Inc.
Example Fields That Can Flourish

- **College of Computer-Engineering and Computer Science (CECS):** Nanoelectronics, Nanomaterials science and engineering, Microbatteries and MEMS (micro-electromechanical systems)

- **College of Optics and Photonics:** Integrated photonics, Nanophotonics, Optoelectronics, biophotonics, Photovoltaics, Plasmonics and Metamaterials

- **College of Sciences:** Low-dimensional solid-state physics, Nanoscience

- **Explored Areas of Hire:** Next-generation computing, Topological electronics and photonics, Integrated space photonics and electronics, Integrated quantum photonics and communication, Optical interconnects and heterogeneous electronic-photonic integrated circuits, Novel metamaterials and nano-devices
<table>
<thead>
<tr>
<th>Faculty Position Description</th>
<th>Anticipated Areas of Expertise</th>
<th>Department/Unit</th>
<th>Hiring Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endowed Chair in Nanophotonics for Optical Computing</td>
<td>Optical artificial neural networks; Analog optical computing hardware; Optic-enabled deep learning; Optical convolutional accelerators</td>
<td>CREOL, COP</td>
<td>August 2023</td>
</tr>
<tr>
<td>Tenure-Track Assistant Professor in Quantum-Optic Computing</td>
<td>Optical quantum computing devices and circuits; Integrated quantum photonics; Large-scale quantum photonic circuits</td>
<td>CREOL, COP</td>
<td>August 2024</td>
</tr>
<tr>
<td>Tenure-Track Assistant Professor in Neuromorphic Computing</td>
<td>Neuromorphic electronic computing; Neuromorphic integrated circuits for big data and artificial intelligence; Nanoelectronics for machine learning</td>
<td>Electrical &amp; Computer Engineering, CECS</td>
<td>August 2023</td>
</tr>
<tr>
<td>Tenure-Track Assistant Professor in Nanomaterials for Computing</td>
<td>Novel nanomaterials for artificial learning; Quantum materials and devices; Metamaterials for deep learning; Novel materials for spintronics</td>
<td>Materials Science &amp; Engineering, CECS</td>
<td>August 2023</td>
</tr>
<tr>
<td>Tenure-Track Assistant Professor in Spintronic Computing</td>
<td>Neuromorphic spintronics; Spintronic quantum computing; Spintronic integrated circuits; Scalable spin-based devices</td>
<td>Physics, COS</td>
<td>August 2023</td>
</tr>
<tr>
<td>Tenure-Track Assistant Professor in Superconductor Computing</td>
<td>Superconductor quantum computing; High-temperature superconducting circuits; Large-scale Josephson junction circuits</td>
<td>Physics, COS</td>
<td>August 2024</td>
</tr>
</tbody>
</table>
• **Joint Search Committee**: There are three members in this committee, who represent each college and are appointed by the Deans. Currently, they are S. Fathpour (COP), R. Abdolvand (CECS) and R. Peale (COS)

• It was proposed that the PI (S. Fathpour) serves as the chair of the Joint Search Committee
Regional and National Impacts

• Improved standing nationwide and enhance the university’s future chances in attracting talent in all areas related to advanced semiconductor science and technologies
• The new 6 faculty positions constitute more than 20% increase in research-active faculty members that utilize cleanroom facility
• Complementing local partnerships such as those with SkyWater/BRIDG and FiconTEC
• Combined regional synergic activities in the advanced semiconductor technologies can potentially make Central Florida a national hub for next-generation semiconductor industry

Map of NNCl sites in the US, stressing no presence in the State of Florida