# Birck Nanotechnology Center
## Future Centers of Excellence

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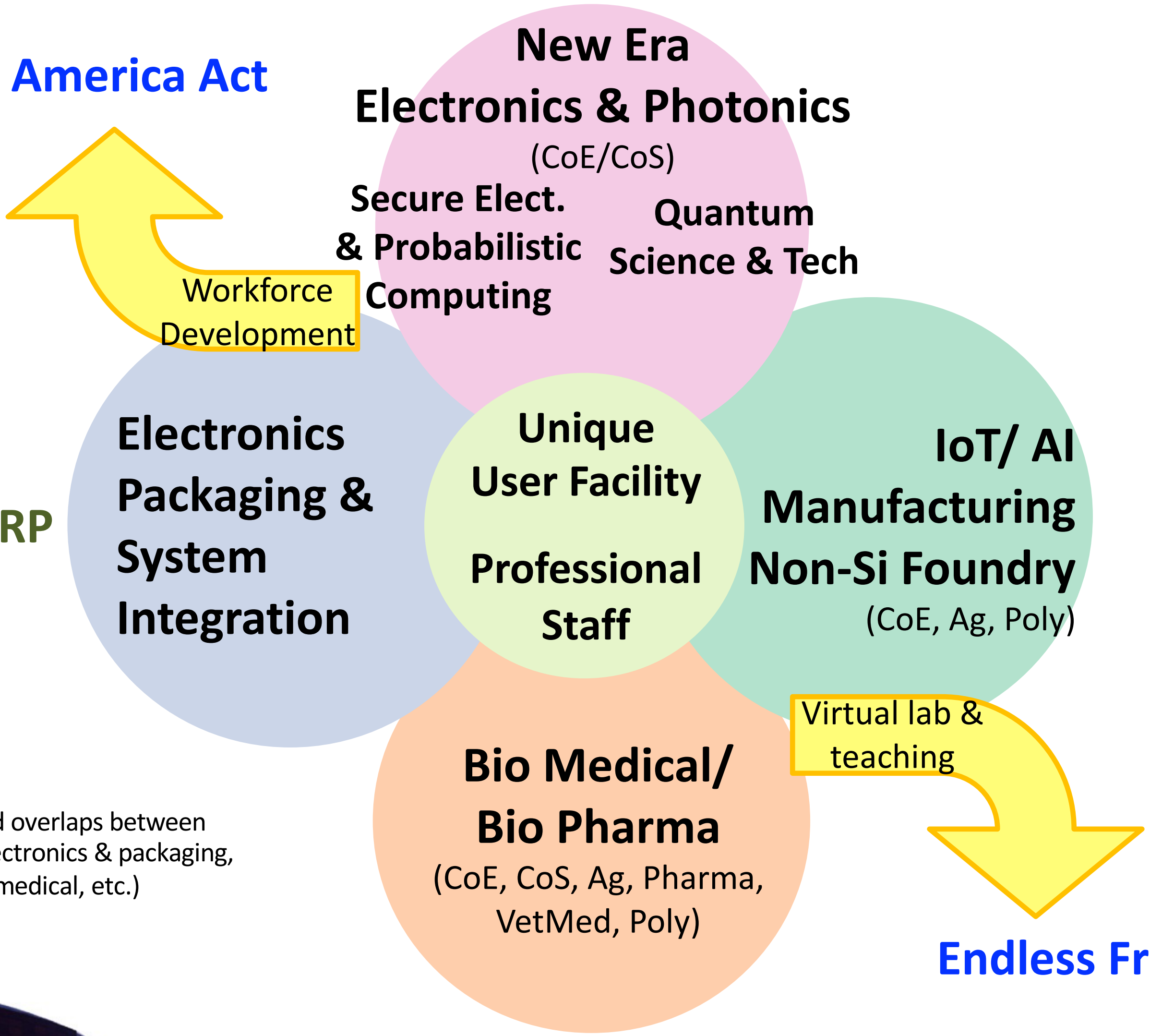
# Centers of Excellence Bringing Together Different Colleges and Purdue Centers



iGSDI

PINE

PQSEI

nanoHUB

CHIPS For America Act

**New Era Electronics & Photonics**
(CoE/CoS)

**Secure Elect. & Probabilistic Computing**

**Quantum Science & Tech**

Workforce Development

**Electronics Packaging & System Integration**

CTRC, SRC CHIRP

**Unique User Facility**

**Professional Staff**

**IoT/ AI Manufacturing Non-Si Foundry**
(CoE, Ag, Poly)

SMART, PI4D, C4E

Virtual lab & teaching

**Bio Medical/ Bio Pharma**
(CoE, CoS, Ag, Pharma, VetMed, Poly)

Endless Frontiers Act

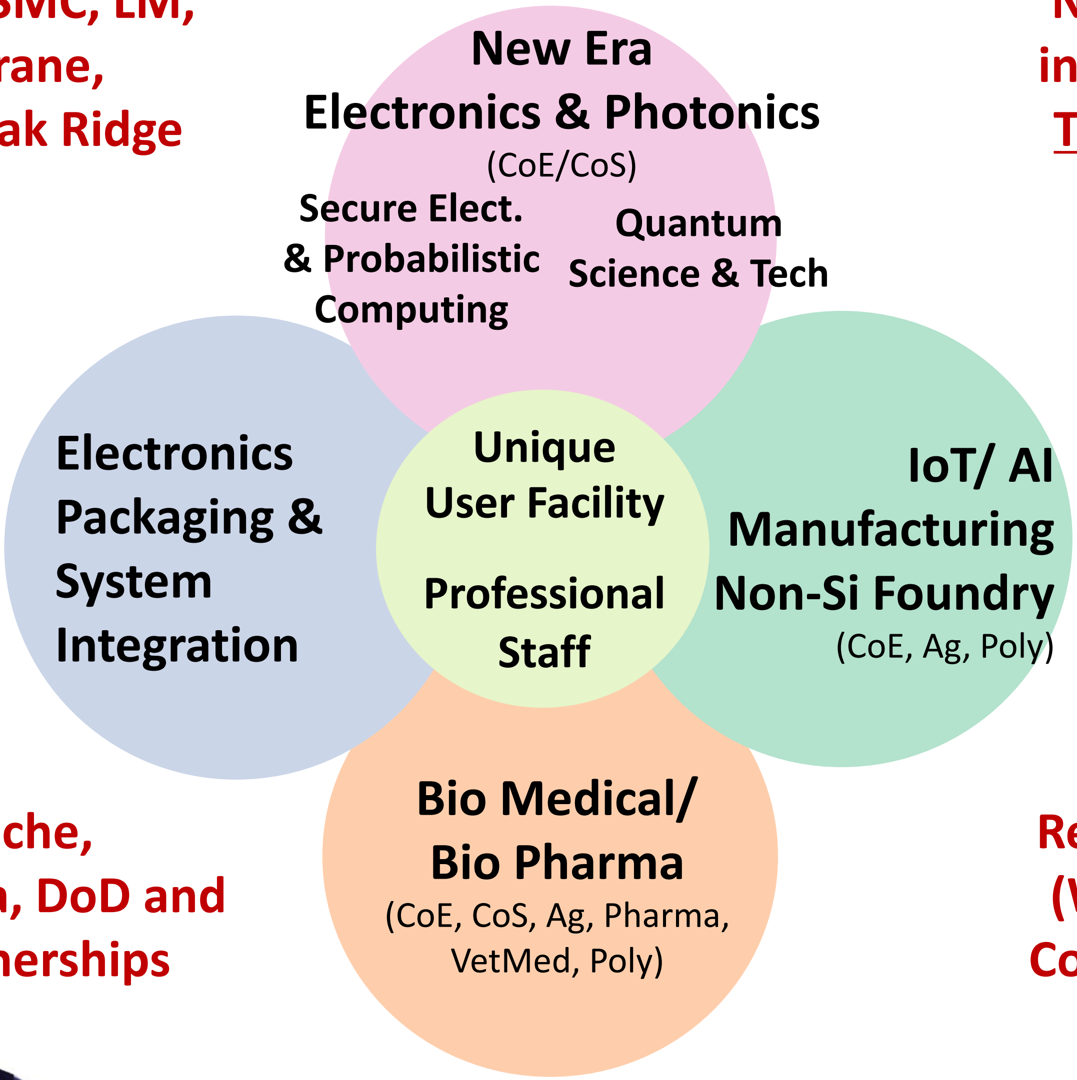
PIIN, Bindley, LyoHUB

* There are synergies and overlaps between sub-areas (e.g. secure electronics & packaging, system integration & biomedical, etc.)

# Centers of Excellence Leveraging National Initiatives and Strategic Partnerships

Microsoft, SRC, TSMC, LM,
Intel, Samsung, Crane,
Draper, Sandia, Oak Ridge

National Initiatives
in Quantum, AI and
Trusted Electronics



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Eli Lilly, Elanco, Roche,
Industry Consortia, DoD and
National Lab partnerships

Regional Ecosystem
(WHIN, DP District,
Convergence Build.)

# Rationale

### (1) New Era Electronics & Photonics

Enhance our leadership as top centers in quantum and microelectronics. New directions in quantum electrodynamics/ metrology/ photonics-superconducting hybrid, Quantum/AI. Unique 8” tools for training and characterization. Collaborations with TSMC, Intel, Microsoft, Samsung, etc., bring together researchers from Physics, Chemistry and ECE.

### (4) IoT/AI Manufacturing

Expanded SMART industry consortium (Applied Mat., Bayer, UTC/Carrier, Fluke/Landauer, Sartorius, AeXonis); IoT devices for healthcare and regional testbeds in digital ag and manuf.; shared lab for MiBio (ChemE, Chem, BME, HHS), Future Center of Excellence in AI/ R2R manufacturing and the basis of non-silicon foundry near Purdue

### (2) Electronics Packaging/ Systems

Brings unique back end of the line (BEOL) fab capabilities to SRC Packaging, Cooling Technology Research Centers (20 industry members), and DoD Cornerstone Microelectronic Workforce Consortium. Enable asymmetric response to major federal initiatives in Secure Electronics, Harsh Environments, and others. Strengthen collaborations between ME, MSE, ECE, Physics

### (3) Bio Medical/ Biopharma

Soft material microfabrication for implantable bioelectronics, soft robotics and organ-on-a-chip for STEM cell and cancer research. Industry partnership (Eli Lilly, Elanco, Roche, …). Synergy with the state-of-the-art packaging lab. Expand LyoHUB industry consortium with pilot-scale modules with robotics/ automation. FDA training

# BNC Resident Faculty, Research Thrusts and Collaborations

| Research Thrusts | | Resident Faculty |
|---|---|---|
| **Electronics** | 6 | Alam, Appenzeller, Z. Chen, Janes, Morisette, Ye |
| **Photonics** | 9 | Alaeian, Bermel, Boltasseva, Hosseini, Hung, Jacob, Kildishev, Narimanov, Shalaev |
| **MEMS/ Microsystem** | 4 | Bhave, Mohammadi, Peroulis, Weinstein |
| **Physics (Cond. Matter)** | 6 | Y. Chen, Ma, Malis, Manfra, Rohkinson, Hung |
| **Thermal/ Packaging** | 8 | Marconnet, L. Pan, Ruan, Warsinger, Weibel, Xu, Yazawa |
| **R2R/ Manufacturing** | 8 | Cakmak, Chiu, Mei, Rahimi, Shakouri, Stanciu, Wei, Ziaie |
| **Nanobio/ Soft Materials/ LyoHUB** | 13 | Cappelleri, Garner, Han, Lelievre, Mei Mcnally, Panigrahi, Savran, Suter, Verma, Wereley, Alexeenko, Topp |
| **Material Growth/ Char.** | 4 | Capano, Marinero, Na, H. Wang |
| **AFM/ Surface** | 4 | Raman, Reifenberger, Rhoads, Wagner |

## (1) New Era Electronics & Photonics

- **Secure Electronics**
- **Quantum Electrodynamics/ Metrology**
- **Quantum Photonics /Supercond. & AI**

**Collaborators:** Lundstrom, Datta, Upadhyaya, T. Li, Sen Banerjee, Weiner, Agrawal, Kais, Klimeck, Hood?, ,…

## (2) Electronic Packaging/ MEMS/ System

- **3D heterogenous integration**
- **BEOL Hybrid Tools/ Devices**

**Collaborators:** Handwerker, Blendell, Subbarayan, Strachan, Chawla, Jung?, Jones?,…

## (3) Bio Medical/ Soft Mat./ Biopharma

- **Implantable Electronics, Organoid on a chip**
- **LyoHUB**

**Collaborators:** H. Lee, C-H. Lee, Jayant, Nawrocki, Wu, K. Park, Pinal, Carvajal, Irazoqui, Linnes, Martinez, Vlachos, Chortos?, Proctor?, Bao?, …

## (4) IoT/AI Manufacturing

- **Low-cost IoT manufacturing / Regional Testbeds**
- **Resilient AI Network for Manufacturing**

**Collaborators:** Boudouris, Dou, Allebach, Bagchi, B. Ribeiro, Bertino, Mansson, Tien Li, Kumar, Youngblood, Tallman, Chatzidakis, Cheng, Newell, Salas, …

# Other Potential Centers

- Quantum + Artificial Intelligence
- Sustainability, Nexus of Food/Energy/Water, Carbon Economy
- 3D Nanomanufacturing
- Collaboration with other Discovery Park Centers (Bindley, PIIN, PI4D, C4E, iGSDI, IDSI, etc.)
- Herrick/ Zucrow Collaboration? (DoD, DoE)
- ….

# How Can Purdue Compete with Other Centers of Excellence?