

Firm name: Bubbles & Café Inc

Project title: Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Growth in Microgravity

PI: ILAKKUVASELVI MANOHARAN,
CEO, BUBBLES & CAFE INC.

NASA Topic Title: Closing Capability Gaps to Accelerate In-Space Production
Applications in LEO

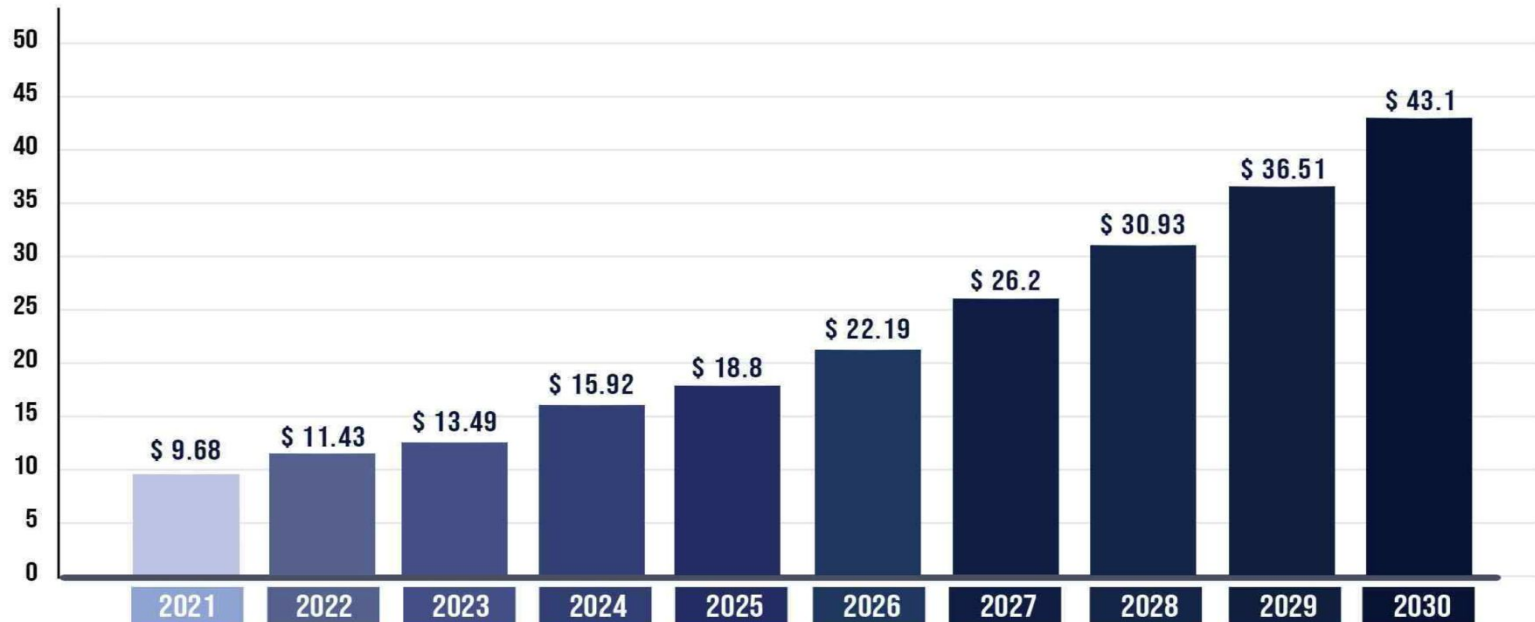
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Part 1: The Market Opportunity: Market segment and potential commercial total addressable market (TAM)

**PRECEDENCE
RESEARCH**

NANOMATERIALS MARKET SIZE, 2021 TO 2030 (USD BILLION)



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Global Nanomaterials Market

Share, by Application, 2022 (%)



● Aerospace ● Automotive ● Medical ● Energy & Power
● Electronics ● Paints & Coatings ● Other



GRAND VIEW RESEARCH

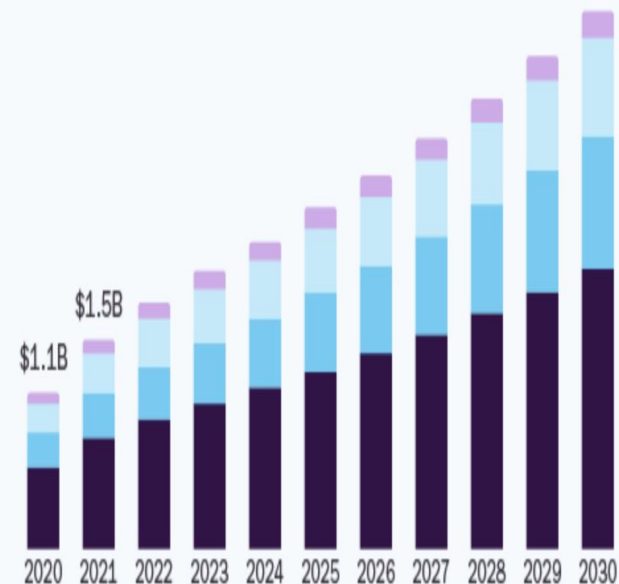
\$10.9B

Global Market Size,
2022

Source:
www.grandviewresearch.com

U.S. Gold Nanoparticles Market

Size, by Product, 2020 - 2030 (USD Billion)



● Medical & Dentistry ● Electronics ● Catalysis ● Others



GRAND VIEW RESEARCH

21.2%

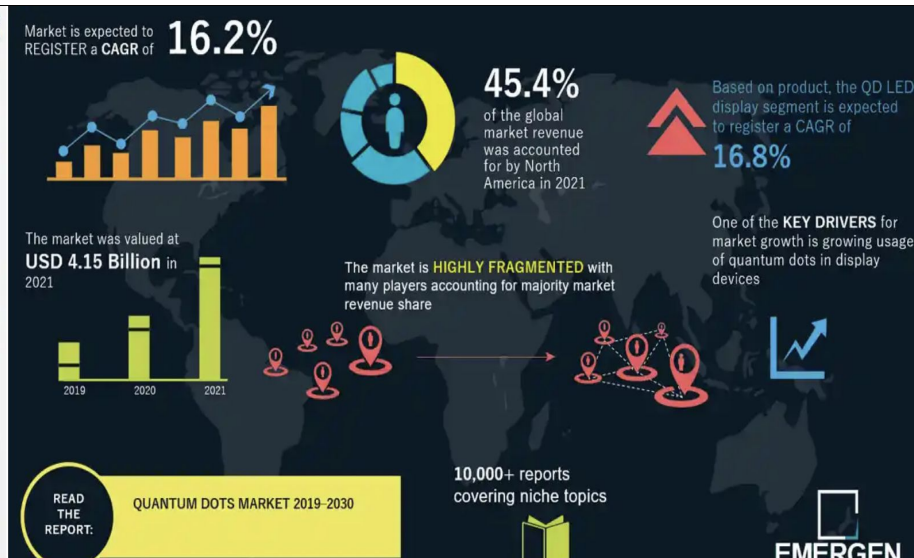
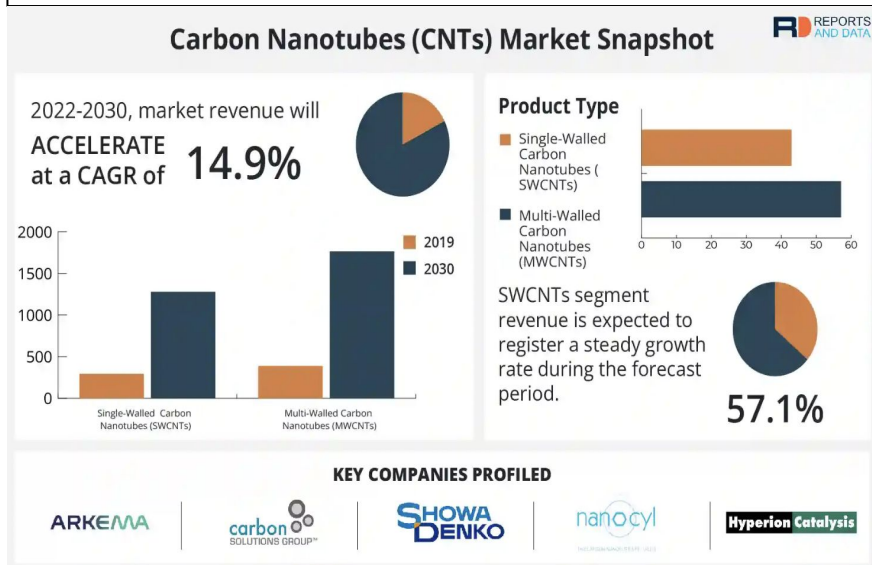
U.S. Market CAGR,
2023 - 2030

Source:
www.grandviewresearch.com

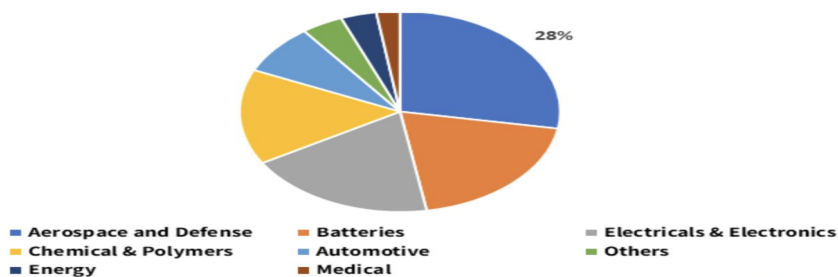
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Global Carbon Nanotubes Market Share, By Application, 2022



Nanotechnology in Drug Delivery Market

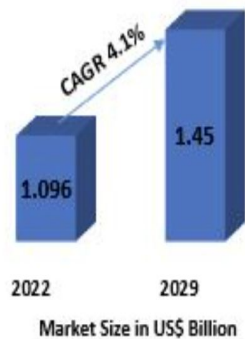


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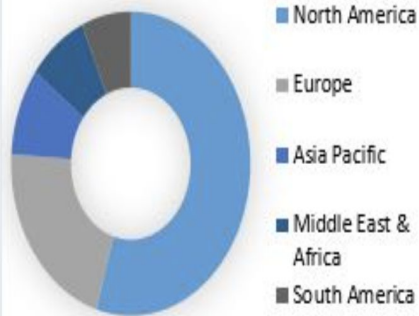
Platinum Nanoparticles Market



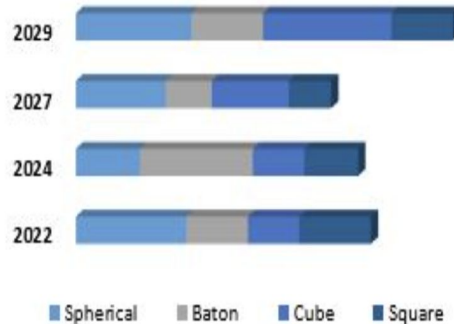
Key Players

Sigma Aldrich	Nanostructured &
BBI Solutions	Amorphous Materials
Solaris Nanosciences	EPRUI Nanoparticles &
Tanaka	Microspheres
NanoRods LLC	US Research
Nanosphere	Nanomaterials
Nanopartz Inc.	Meliorum Technologies
NanoBio Chemicals India Pvt Ltd.	Strem Chemicals
American Elements	nanoComposix
	Tanaka Holdings

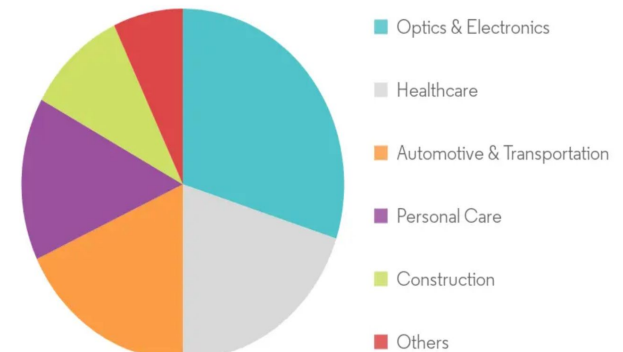
Regional Analysis in 2022 (%)



Product Segment Overview



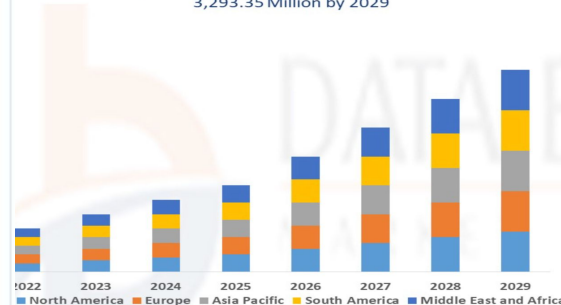
Metal Oxide Nanoparticles Market, Revenue (%), by End-user Industry, Global, 2019



Source : Mordor Intelligence



Global Nanocrystal Solar Cell Market is Expected to Account for USD 3,293.35 Million by 2029



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Source: Data Bridge Market Research Market Analysis Study 2022

Global Nanocrystal Solar Cell Market, By Regions, 2022 to 2029

2022
2029

DATA BRIDGE
MARKET
RESEARCH



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Global Lipid Nanoparticles (LNPs) CDMO Market Research Report



North America



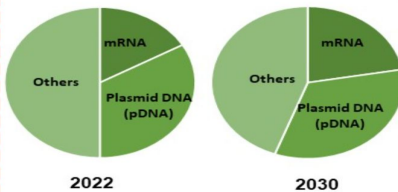
Market Size:
US\$ 161.7 Mn
(2022)

CAGR
(2022-2030)

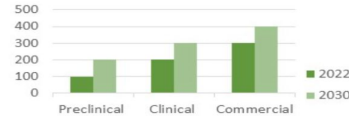
13.80%



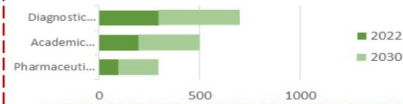
By Product:



By Scale Of Operation :



By End-Users :



Key Players:



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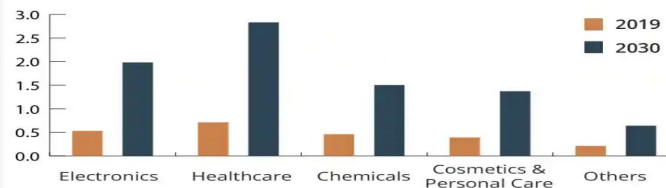


INSIGHT ACE ANALYTIC

Gold Nanoparticles Market Snapshot

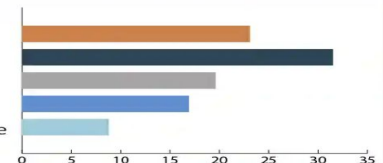
RD REPORTS AND DATA

2022-2030, market revenue will
ACCELERATE
at a CAGR of **12.6%**

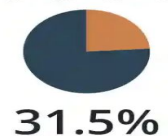


End-use

Electronics
Healthcare
Chemicals
Cosmetics & Personal Care
Others



Healthcare segment accounted for largest revenue share in 2021, and is expected to register rapid revenue growth rate during the forecast period



KEY COMPANIES PROFILED



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Part 1: The Market Opportunity: Target customers & competitive landscape

Key Market Drivers:

- Increasing demand for advanced materials
- Growing emphasis on high-performance technology
- Expanding applications in various sectors
- Advancements in nanotechnology research

Key Takeaways:

- The nanocrystal market offers substantial growth prospects.
- Diversification across industries reduces risk.
- Innovation in nanomaterials is critical for future technologies.

Target customers:

Nanocrystal synthesis caters to a broad customer base:

- Research Institutions: Supporting fundamental research.
- Pharmaceutical, Electronics, and Energy Industries: Enhancing drug delivery, semiconductor components, and energy storage.
- Materials and Coatings, Environmental Tech, and Consumer Electronics: Developing advanced materials, green technologies, optics, and displays.
- Medical Device, Government, NASA, ISS, Space Tech, and Startups: Enabling innovation in imaging, space exploration, and various nanotech applications.
- Quantum Technology Providers: Collaborating with quantum technology companies to integrate nanocrystals into quantum computing and sensing applications.

Competitive landscape and potential competitors:

- No direct competitors in the combination of spintronics, quantum sensors, and fluid dynamics for nanocrystal synthesis in microgravity.
- Potential indirect competition from:
 - Traditional nanomaterial manufacturers.
 - Quantum technology providers.
 - Space technology companies.
 - Materials science research institutions.
- Unique approach in microgravity offers precise nanocrystal control and customization.
- Success could establish project as a leader in nanomaterials, attracting collaborations and partnerships.

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Part 1: The Market Opportunity: Commercial Intent—Value Proposition

Commercial Development

- Medical & Biomedical: Tailor nanocrystals for drug delivery and targeted therapy, aligning with Cancer Moonshot goals.
- Electronics & Photonics: Enable high-performance semiconductors and photonics devices, supporting the Chips Initiative.
- Catalysis & Materials Science: Improve industrial processes and catalysis, impacting renewable energy and environmental solutions.
- Advance quantum computing and sensing technologies.
- Innovation in space technology, including satellite systems, space resource utilization, and sustainable energy solutions, to drive economic growth and scientific progress.

Risks & Mitigations

- Technical Complexity: Rigorous testing and iterative development to address technical challenges.
- Regulatory Compliance: Establish a robust compliance strategy for nanomaterial safety and regulatory adherence.
- Market Adoption: Develop effective marketing and collaboration strategies for industry integration.
- Market Competition: Maintain a competitive edge through innovation and patent protection.
- Cost Management: Implement cost-effective production methods and efficient supply chain management.

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Part 1: The Market Opportunity: Commercial Capability—How Will the Innovation Enter into a Market?

Current and Future Company Capitalization Efforts

- **Federal Grant Pursuit:**

- Actively seeking federal grants, including NSF Project Pitch, ISS National Lab NLRA 2023 - 10 and other NSF and NASA research grants.
- Emphasis on aligning innovation with the priorities of grant-awarding agencies like Cancer MoonshotSM and CHIPS Act initiative

- **NSF Project Pitch:**

- Ongoing & past efforts to secure NSF funding.
- Proposals aligns with NSF's mission and objectives to foster innovation and have the potential to positively benefit society and to lead to significant outcomes in the commercial market.

- **ISS National Lab NLRA 2023 - 10:**

- Commitment to leverage the ISS research environment.
- Ongoing & past efforts to secure funding from CASIS.
- R & D aligns with In-Space Production Applications, Advanced Materials and Manufacturing and advanced technologies for biomanufacturing.

- **Future Capitalization:**

- Plans to secure federal grants
- Open to potential partnerships, investments, or funding rounds.
- Open to venture capital, angel investors, and strategic partnerships in the end of Phase 2.

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Approach:

- **Tech Transfer & Collaboration:** Partner with space agencies for tech transfer, share data.
- **Industry Partnerships:** Collaborate with nanotech and space firms.
- **Customization Services:** Offer tailored nanocrystals for industries.

Path to Market:

- **Proof of Concept:** Validate tech through pilot projects.
- **Prototype Development:** Create systems for microgravity.
- **Regulatory Compliance:** Ensure space safety standards.
- **Market Entry:** Target space, biomedical and electronics markets.
- **Scaling Production:** Scale up production for cost-efficiency.

Revenues:

- **Product Sales:** Sell synthesis systems and modules.
- **Service Contracts:** Offer maintenance and customization.
- **Licensing:** License tech to other firms.
- **Consulting:** Provide tech consulting services.
- **Research Collaborations:** Collaborate for research funding.

Market Expansion:

- **Diversification:** Explore new markets.
- **Continuous Innovation:** Stay ahead in nanotech. Innovate, Collaborate, Grow.

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Part 1: The Market Opportunity: Intellectual Property (IP) Protection Strategies

- **Cybersecurity Best Practices**
 - Implement robust cybersecurity measures.
 - Use encryption, firewalls, and intrusion detection.
 - Regularly update and patch software.
- **Exclusive Research Involvement**
 - Sole researcher (PI - ILAKKUVASELVI MANOHARAN).
 - Limited access reduces IP leakage risk.
- **General IP Protection**
 - Use NDAs with collaborators, employees, and contractors.
 - Maintain meticulous IP development records.
 - Consider patent filings and trade secret protection.
 - Conduct employee IP protection training.
- **Regular IP Audits**
 - Periodically assess and update strategies.
 - Engage legal counsel for guidance.
- **Monitoring and Detection**
 - Implement monitoring for unusual data access.
 - Swiftly detect and respond to breaches.

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Part 1: The Market Opportunity: Assistance and Mentoring

Plans for Securing Technical and Business Assistance

- **Strategic Collaborations:** Engaging with ISS and ISS implementation partners and Federal research laboratories to access resources, expertise, and specialized equipment, optimizing research efficiency, and mitigating risks.
- **Cost-effective access to equipment:** PNF at the University of Chicago accelerates and supports innovative research and development efforts by providing cost-effective access to cutting-edge equipment and resources.
- **Business Support Ecosystem:** Consideration to leverage state assistance programs, SBDCs, Manufacturing Extension Partnership centers, and federal programs for valuable business guidance, support, and scaling efforts.
- **Collaborative Network:** Emphasizing a commitment to a collaborative approach, building partnerships and support networks to aid in future growth, development, and innovation.
- **External Resources:** Consideration to leverage external infrastructure and funding to contribute to overall company success.

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Part 1: The Market Opportunity: Evidence of follow-on funding commitments

1. A letter of commitment* for follow-on funding and/or product sales.
2. A letter of commitment* for matching funding is to be provided for a future Phase II-E application.
3. A letter of capital commitment, signed by the proper authority (CEO, CFO, etc.), that indicates a commitment to provide funding and/or product sales, should the Phase II project be successful, and the market need still exists.
4. Letter of intent to provide funding should the Phase II project be successful, and the market need still exists.
5. A specific plan to secure Phase III funding.

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Part 2: Key Personnel/Team

The team consists of the solo founder Ilakkuvaseelvi (Ilak) Manoharan, a highly skilled and experienced professional with a diverse background in engineering, entrepreneurship, research, and product management. Ilak's expertise and qualifications are well-suited to the project's goals, which involve nanomaterials, fluid dynamics, spintronics, and commercialization.

Ilakkuvaseelvi (Ilak) Manoharan:

- Founder, CEO, Scientist, Researcher, and Engineer at Curious & Connected NPO, where Ilak actively engages in scientific research and oversees operations.
- Founder, CEO, Scientist, Engineer, and Product Manager at Bubbles & Cafe, leading innovation and product development.
- Proficiency in mobile app development (iOS, Android), data engineering, data science, and backend development.
- Experience in renowned companies, including JPMorgan Chase, Accenture, McDonald's, and Caterpillar, with roles ranging from lead application developer to solution architect.
- Holds a Master's degree in Electrical Engineering with a minor in Software Engineering, along with a Bachelor's degree in Electronics and Instrumentation Engineering.
- Experience in successful patent filing for the AIOS IoT Smart Restaurant concept.

Ilak's interdisciplinary background, combining electrical engineering, software engineering, and entrepreneurship, equips her with a versatile skill set for addressing the challenges and opportunities presented by nanotechnology research and commercialization.

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Part 3: Facilities and Equipment

The Pritzker Nanofabrication Facility (PNF) is an open use facility that is available for use for all trained users in accordance with the terms of their user agreements. The Pritzker School for Molecular Engineering (PME) at the University of Chicago operates the PNF as a shared, user-fee based cleanroom facility, comprising 12,000 square feet of class 100 cleanroom space in a bay/chase arrangement, all housed in the first basement of the W. Eckhardt Research Center. In addition, the PNF also has about 15,000 square feet of disposable space for cleanroom operations and storage. The cleanroom is fully operational, with a full suite of lithographic, deposition and etching tools at the disposal of all cleanroom users. The tools include: Plasma ICP etchers using chlorine and fluorine gases for etching metals and dielectrics; ICP plasma deposition tools including 100% and 5% silane gas for Si, SiN and SiO₂ growth; metal and dielectric sputter tools; ebeam evaporators for metals and dielectrics; a 6 inch wafer-compatible furnace for oxide and nitride thermal growth, including LPCVD; contact and stepper optical lithography tools; a high resolution, state-of-the-art electron beam lithography system; inspection tools including SEM, optical microscopy, AFM, profilometers, ellipsometry, white light interferometers. A FIB-SEM is planned for later purchase. The facility includes (to date) six full-time staff that operate, train, and maintain the suite of tools, all on a recharge basis. The tools that are available in this facility more than suffice to perform all the fabrication necessary for most nanofabrication needs.